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THE PROBLEM OF THE ASSISTANT PROFESSOR.* II

We now pass to the second division of our subject, which, because of its somewhat broader aspects, requires a slightly different mode of presentation.

Questions 18, 19 and 20 were prepared with a view to elicit information upon the extent of academic freedom and of participation in the solution of university problems, enjoyed by assistant professors.

Says President Eliot in his most valuable and suggestive "University Administration":

> For determining the educational policy of a seat of learning, the faculties are the most important bodies in the entire institution. . . . It devolves upon the faculties . . . to discern, recommend and carry out the educational policies of the institution. . . . Membership in a faculty should therefore be limited to professors, associate professors and assistant professors, and to those instructors who have received appointments without limit of time. . . . It is of the utmost importance that every faculty contain enough young men to bring forward in debate the views and feelings of the recent college generation. To have its administration fall chiefly into the hands of elderly men is a grave misfortune for any institution. There is always good work that veterans who retain their physical and mental alertness can do; but the control of a university's policy should not be confided to them alone. . . . By the vitality, inventiveness and enterprise of its faculty, it is safe to judge any institution of learning.

President Hyde, in his refreshing paper on "Personality and College Professors,"[6] adds to this:

* A paper prepared for the eleventh annual conference of the Association of American Universities, on behalf of Leland Stanford Junior University, by Professor Guido Hugo Marx and presented by Professor Charles H. Huberich.

[6] *The Outlook*, August 21, 1909, pp. 931–7.

Because, in an experience of twenty-four years, I have seen 75 per cent. of all administrative reforms advocated and accomplished by men under thirty-five, I heartly endorse President Eliot's principles of juniority as the distinguishing mark of a progressive as distinct from a stagnant institution.

The three university presidents, of those not now in service, who have exerted the greatest formative influence upon the modern American university, are Presidents Eliot, Gilman and White. The first took up his presidential duties at Harvard at the age of 35; the second at California at the age of 41 and at Johns Hopkins at 46; the third at Cornell at 35.

In view of the foregoing facts, the extent of participation by men of 37 in the direction and control of educational policies of the several universities, disclosed by the following typical answers, is enlightening. The replies were formulated from a few more than a hundred received from twenty institutions. Unless otherwise stated, three or more answers were received from the institution. A composite reply is arranged, to give the range of replies from each individual institution, as representing the point of view of the assistant professor.

Query 18*a* was: "What are your opinions concerning the status of the assistant professorship in sharing in the determination of general policies of your institution?"

The replies:

1. "The policies of the university are really shaped by the president." "Assistant professors have a vote in the council, just as the full and associate professors have. They do not often initiate movements or policies, but have the full right of discussion, voting, etc." "Nothing more to be desired."

2. "Assistant professor has status a little above janitor." (Less than three replies.)

3. "Fairly satisfactory here." "They should have a full share in administrative and departmental policy, because unless they have such a share, with its responsibilities and the recognition resulting from it, the better part of their experience, idealism and progressiveness is wasted."

4. "Fairly satisfactory." (Less than three replies.)

5. "Satisfactory." "They have as much influence, nearly, as full professors." "They have little share in the determination of general policies."

6. "There are no differences [between assistant and full professors] in these matters." (Less than three replies.)

7. "Very little direct influence at present." "He has a seat and voice in his college faculty, but not in the general university senate." "Not much share."

8. "Have a vote in faculty meetings." "Share but slightly in the determination of general policies." "Only through suggestions to the head of the department." "General policies are determined largely in meetings of the faculty heads of departments."

9. "No voice whatever in determining institutional policies." "At present assistant professors have no share." "None."

10. "Very little." "Mostly in hands of the deans." "Think assistant professors little less powerful than full professor. Believe a suggestion from either would be considered by the administration with equal care." (Note inference to be drawn from this last sentence. A side-light is thrown by the volunteered statement of one who left this institution for a larger one: "Conditions in this respect were highly unsatisfactory at ————.")

11. "Not being member of council, can not answer." "Believe most assistant professors to be of ripe enough age and sober-minded enough to give some good ideas." "No discrimination save in excluding new assistant professors from council for three years." "It is all it should be."

12. "Almost no share." "Has little influence; mostly done by older men." "Mostly in hands of heads of departments. Here the elder statesmen are in control."

13. "As a rule, given altogether too little say." "Is given no say in policy of institution." "Should be heard in regard to such questions." "Has a vote in all faculty actions." "When a division is called for in faculty meeting, professors have two votes, assistant professors one vote and instructors no vote."

14. "Satisfactory in all respects. Depends entirely on his individual ability." "As to general policies, all assistant professors have a vote, as well as professors and deans, in the council."

15. "Left to heads of departments." "Incidental [share] only." "Should be given full vote on questions pertaining to institution policy." "The assistant professors are members of the general faculties in which they teach."

16. "Should have a vote in all matters submitted to members of the institution." "I am in the council which determines the policy. Am elected by confrères below rank of clinical professor. Other assistant professors are members of the 'faculty,' which is without power of initiative." (Less than three replies.)

17. "My share is as large as that of the average full professor." "In my case I can see no difference between assistant and full professors in this respect." "We enjoy all the privileges of full professors, but receive smaller salaries. It seems to me that is about the only distinction here."

18. "Depends upon personality and attainments of the assistant professor." "They have a great deal of influence here with us, and vote in faculty and committee meetings just as full professors do." "Perfectly satisfactory."

19. "An appropriate share." "Have votes on all questions in faculty meetings and serve on many important committees."

20. "No influence." "General policies are determined entirely by the full professors."

The foregoing replies show considerable range of institutional policy. Taken with their contexts (necessarily omitted here) they also disclose a prevailing conception of a faculty, as a body scarcely so important and influential in its functions as the ideal quoted from President Eliot at the beginning of this section. In this light, such apparently discrepant answers as, for instance, those grouped under institution 5, fall into harmony, and so interpreted would mean that the faculty, as a whole, bears but small part in shaping policies, but in that part the assistant professors have nearly the influence of the full professors.

Our next query is directed at one of the most sensitive points in the present-day university organizations—the status of the assistant professor in sharing in the determination of departmental policy, curriculum and assignment of courses. The replies are grouped by institutions, although, under the prevailing system of departmental organization with permanent heads possessing ill-defined powers, it is natural to expect greater variations within the individual institutions, according to the interpretation of their duties by the various department heads.

Query 18*b*, replies:

1. "The head has absolute power." "According to the disposition of the head of the department." "Departments vary in this university. In some it is done by conference and general meetings. In some (——— *e. g.*) we are called upon occasionally for suggestions in writing, all decisions resting with the head of the department. We have had about three department meetings in fifteen years. We get in writing our assignment of courses and hours from the head of the department." "Departmental policy (——— department) very democratic. Majority of questions determined by vote of entire department. Individual wishes consulted wherever feasible."

2. "Is consulted about only his own courses." (Less than three replies.)

3. "Fairly satisfactory."

4. "Satisfactory in my department." "Very pleasant relations with the head of department." (Less than three replies.)

5. "Considerable, but (in general) insufficient share." "They have little to do with it. The system of departmental headship is to blame for this. This is the most detrimental arrangement within our universities at present." "Unsatisfactory. Too much power is centered in the head of the department. The assistant professor given little chance to influence departmental policy." "Have been practically full professor except in salary."

6. "No difference [between assistant and full professors] in these matters at ———." "Should have an advisory capacity, but determination of course of conduct should be in hands of heads of departments." (Less than three replies.)

7. "Not much share." "He is usually con-

sulted, but there is no formal obligation to consult him." "In our department, the assistant professor is an important factor in all departmental policies, and helps form these policies." "A large share."

8. "In departmental policy more attention is paid to his suggestions [than in general policy]." "My opinions are given careful consideration." "Have great range of liberty. The professor is one of the best in this regard that I ever knew." "Departmental policies in the ——— department at present determined by the two heads. Have poor opinion of any two-headed arrangement." "Such things should be determined by conference of all members of the departmental staff."

9. "Good in some departments, poor in others." "Share to a very limited extent." "Am freely consulted by the head of the department relative to all matters of departmental policy." "Should have a vital part." "Should be consulted."

10. "No share." "Voted upon in general faculty meetings." "An equal voice, almost, as to departmental affairs. Great freedom in expression of opinions, etc." "We are very democratic in the department." "Should be consulted, and, I believe, is here."

11. "Depends upon the department." "Not given enough responsibility to give them an active interest in the administrative work of the institution, or to encourage loyalty to it." "Should have voice in planning work and getting just recognition for what they do." "Suggestions have been received for all they were believed to be worth—perhaps not all I thought." "I have as much voice in these matters as if I were a full professor." "Well off in this respect." "All it should be." "In ——— department conditions practically ideal."

12. "Its influence felt a little, but not much." "Very little; not consulted at all." "Influence in proportion to favor enjoyed in eyes of head of department."

13. "Shares none too much." "Very little say." "Should be heard in regard to such questions." "Should be subject to the head of department." "In ——— department, have a voice determining departmental policy." "Too many professors think they should have sole control. 'Their policies might be disrupted.'"

14. "In the large departments his influence is small in determining [these matters]; in small departments he very often takes the place of the professor or head of the department in this line of work. In many cases has entire charge of department and is assistant professor in name only." "I have independent charge of [my field]." "In our department we have voice in the determination of the nature of the work." "The professor of ——— here decides all matters of departmental policy, curriculum and assignment of courses."

15. "In my department the head makes his own policies and assigns courses, but in some departments the assistant professors are consulted." "Suggestive share." "Should be consulted and allowed to help in this part of work."

16. "Should be consulted in the same way as any full professor not head of the department, and should have a vote in all matters submitted to vote of members of department." (Less than three replies.)

17. "No difference here in these matters between assistant and full professors."

18. "They have a great deal of influence here." "Am running the department pending a future policy to be settled in which I have some voice. In other departments assistant professors have advisory functions and are given considerable freedom on the average." "We have some voice—yet the dean has things about his own way." "Share equally with full professors." "Perfectly satisfactory."

19. "Depends largely upon the department head. In my own department the assistant professor is treated on his merits as a man and has as much influence as he deserves. This is not true in many other departments." "Seldom consulted." "Has a full share in departmental matters." "Made to feel that he has a voice in the government of the university and much at stake in his own department." "In general the assistant professor's position in these matters is entirely satisfactory."

20. "In general, little or none." "Much influence in departmental policy."

On the whole, these results, while showing more free participation in departmental than in general university matters, still disclose a state of affairs far from generally democratic.

The next query (18*c*) was in regard to the freedom enjoyed by the assistant professor in the conduct of individual classes. Here the replies are much more uniform, disclosing, in general, a gratifying condition of entire freedom, within the limita-

tions necessarily imposed by correlation of departmental work. There is, however, a plentiful sprinkling of "Should have control," which sounds as if the wish rather than the possession were father of the thought; and also others, of which the following are selected as typical: "None." "Given, usually, freedom in conduct of my classes." "A marked tendency on part of head to urge his own methods." "The professor of ——————— decides the texts to be used and the amount of work to be covered." "The presence of his superior in the room (as is the case in some departments) overseeing his work is, to express it mildly, damnable." "In general, not enough freedom is allowed in those courses which require several sections taught by several men." By way of variety, one reply suggests: "Possibly less freedom and more supervision in some cases might be better."

The aim of query 19 was to disclose the conditions of nature and amount of work required, and whether these reasonably favor carrying on advanced work and intellectual growth. Eleven blank or noncommittal replies were received. Exactly 50 reported conditions from "reasonably" to "extremely" satisfactory. Fifty-one reported conditions as unsatisfactory for one or more of the following reasons: Excess of elementary work; correcting exercises; preparation of laboratory material; committee work; inadequate equipment or library; heavy schedule of instructional work; lack of presence and inspiration of advanced students, and pressing need to spend all available time in supplementing salary.

The actual amount of scheduled work seldom ranged below 10 hours, while as high as 18 appears to be the rule at some of the institutions; as high as 20 is reported and 15 is not uncommon. Here are a few typical, significant replies: "Have ideal research position." "So many do not take advantage of the existing opportunities that I should suppose a reduction of routine duties would not be of advantage to the university." "Conditions not favorable to research beyond that necessary to do teaching well." "Have had almost no time for past five years for research or investigation." "Nights, holidays and vacations must be used for advanced work instead of recreation." "An excess of work is not forced upon us, but it is at hand, and the conscientious man does it to the detriment of his own studies." "It is only by working to the limit that I am able to carry on any research work." "The nature and amount of work demanded of me have made me deem it necessary to aim at good teaching. This has been favorable to intellectual growth but not to research." "The heaviest part of the burden of routine teaching work is borne by those below the rank of professor. There is, however, good opportunity for research and advanced work, if one could be relieved of the awful feeling of lack of material provision for the future, and of family responsibilities not adequately met in the present."

The twentieth question was: What are the conditions governing tenure of the assistant professorship, and are they the best for reasonable independence of thought and action? Typical replies are here grouped, not according to individual institutions, but according to the seven prevailing systems of tenure. In the outset it should be stated that, judging by the entire lack of mention of such in the replies, influences upon tenure from outside the university are gratifyingly non-existent.

1. No fixed policy.

"We have no fixed policy. Would be more

satisfactory to plan for the future with more certainty."

2. Indeterminate. Continued from year to year.

"A man's tenure depends upon his worth." "Assistant professors are not supposed to have independence of thought and action. They are treated as mere assistants just out of college." "Wholly dominated by head of department." "I believe in some cases the institution might be better served if there were not so much independence of thought and action indulged in."

3. Annual appointment.

"The tenure of office depends, if I mistake not, on the wishes (1) of the head of the department and (2) of the president. The actual appointment is for the year only. The condition is unfortunate. It can not tend to independence of thought and action, but only the reverse. It cultivates subservience, toadyism. Its ill effect is intensified by the fact that the assistant professor has no open market in which he may offer his wares; an 'agreement in restraint of trade' virtually exists among leading universities." [?] "The under men are at the mercy of the head of the department, and must submit to any treatment if that head is autocratic or overbearing. Some heads keep their men reminded that they may lose their positions." "Until . . . I cringed and trimmed and was not half a man in my own esteem. I know dozens who are fawning because they feel it necessary." "One can not know whether he is to be dropped out at the end of the year or not. To establish anything like a permanent home seems out of the question." "I think that a three- or five-year term would be preferable, but, if the president is a competent person, I do not regard the matter of great importance." "Continuance in position and promotion are automatic, provided incumbent's efficiency is reasonably maintained." "All that should be asked for."

4. Three years.

"Reasonable for a first term." "Just a little better than one-year tenure." "This seems to me reasonable and fair and theoretically most stimulating for good work." "I am inclined to think that, for one thing, under the three-year tenure worry over future possibilities more than offsets any advantage of stimulus to do good work as means of retaining position." "Conditions by no means best. When I lost out at ——— I had a contract with the president and regents for three years, and two of these years were yet before me. It was deliberate breach of contract. . . . I was never allowed to face my accusers, nor do I know who they were. When I expostulated with the dean, be bullied me. I am not a fighter and could not stand up for myself. He literally bullied me out of the university. . . . The moral shock of this experience I never shall recover from." "I know of no restrictions on thought and action except in a few departments, the heads of which are inclined to be domineering." "In my institution the assistant professor is theoretically independent, having (after three years) an equal voice in the council and the department. Practically, however, he is dependent on the good-will of the head of the department. In the two vital matters of salary and promotion he has no personal access to the president, with whom the formal initiative rests, but is obliged to depend upon whatever representations the head of the department may choose to make. The latter's written recommendation is necessary to promotion, and his report is indeed the basis of all action taken by the president in reference to an assistant professor." "It would seem that the work of the assistant professor should be estimated by more than one person (usually the head of the department) and that some systematic method should obtain by which the appointing and promoting powers should be made acquainted with this work from more than one point of view." "I should say they are here what they are everywhere else: making oneself generally agreeable and setting up no opposition to superiors. Thus are fostered obedience, patience, self-control, submergence of self—all cardinal virtues. Independence of action is not for the assistant professor—his thoughts are his own." "In my experience the conditions are not the best for independence."

5. Four years.

"It is a temporary appointment for four years, and hence in a few cases operates to suppress independence of action and thought, though in most cases I see no such difficulty. Tenure usually depends on good work and usual standards of conduct."

6. Five years.

"Appointments for term of five years each; ordinarily leading to a professorship at the end of the second. There is entire independence." "Tenure dependent upon 'making good.'" "Have had no anxiety about reappointment." "Fact of reappointment being uncertain even though probable, militates against absolute independence of thought and action."

7. Permanent (sometimes after probationary term).

"Utmost freedom." "Removal for cause only." "If I understand the conditions, they are: Good behavior, efficient teaching and reasonable intellectual growth. If this is correct, I think they are the best possible."

No comment is necessary, beyond calling attention to the fact that undue subordination is destructive of character of both subordinate and superior; and conditions which tend to foster it should be tolerated no longer than it will take to get rid of them.

So much for the existing conditions as viewed by the assistant professors. We may compare our impressions from their conclusions with this by President Eliot:[7]

The young American who chooses a university career must then abandon all expectation of riches, and of the sort of luxuries which only wealth can procure. What he may reasonably expect is a secure income, a life-tenure, long vacations, the gratification of his intellectual tastes, good fellowship in study, teaching and research, plenty of books and a dignified though simple mode of life.

We now turn to their suggestions concerning the problem of the assistant professorship, looking toward higher individual or institutional efficiency. These have been grouped as well as may be under separate headings and the most revolutionary one is here given the place of honor:

1. Abolish the assistant professorship.

"Let the instructor be a temporary appointee. After he has clearly proven his ability let him be appointed to a professorship. The instructor should have little or no voice [in administrative matters or those of educational policy] while all the professors should be on an equality."

2. Appointment.

It is urged that the dignity of the position could be increased by the exercise of greater care in appointment, that the aim should be to get good men and then to give them plenty of opportunity for development, holding them responsible for results; and not to be overparticular about degrees and publications. There is nothing very radical here.

3. Clear understanding of status.

Policies should be well-known, clear-cut and loyalty insisted upon; these men wish to cooperate and to that end desire that they be given the confidence of their seniors, and not to be kept intentionally in the dark as to the possibilities of their position or the scope of their work. "Each man (president, professors, instructors, etc.) should have a better understanding with all his associates as to what specific purpose in the world he is trying to accomplish, and in what details he is responsible and in what details only an agent. The whole to be open and aboveboard."

4. Facilities.

In addition to such criticism of limitations of library or lack of equipment from which all members of the staff suffer alike, the assistant professor feels that his needs of office and research room and occasional clerical or stenographic service are overlooked.

More serious than this is the complaint that he has no voice in making up the department budget and that, as a consequence, serious injustice is sometimes done his classes and himself by an indifferent or unfriendly head of department. In the following quotation I change the actual figures —to prevent identification—but retain their essential ratio:

"Our department has $5,000 this year for current expenses. Although second in rank in a department of five men, my grant was only $85. This sum was soon exhausted, and from ——— until next July my laboratories must get along as best they can without funds. In this matter the head of the department has absolute power, from which there is no appeal."

The failure to include in book-lists those which the assistant professor requires for his advanced work and growth is also not unknown.

Facilities for the publication of longer, more ambitious work, rather than short papers, are inadequate. There are occasional instances where he has been urged by the superior, upon whose good-will the permanence of his position and advancement depend, to undertake such a task and upon its completion face the necessity of paying a large sum toward its cost of publication out of his scanty resources.

5. Schedule and curriculum.

The burden of instructional work is too heavy to encourage or even, in many cases, to permit research work. The suggestion is made that there is too great a variety of undergraduate courses offered.

The men should have some share in the advanced

[7] "University Administration," pp.. 98–99.

courses and must be given entire control of the conduct of their own classes except for the natural limitations imposed by the need of correlation of courses. They should be free as to methods, but held strictly accountable to the university for results.

6. Tenure.

The comments on tenure leave no doubt that a short term—like annual appointments—dominated by the head of the department is not wholesome and should not be tolerated. Probationary service, either in rank of instructor, or one term as assistant professor, is recognized as necessary and desirable; but a continued state of uncertainty is demoralizing. No institution—even for the gain of apparently frictionless administration—can afford to pay the price in injury to dignity and character disclosed by some of these letters.

7. Promotion.

The standards for promotion should be formulated, openly stated, and adhered to. It is urged that recognition be given to teaching ability and that promotion depend not solely on research work when the burden of teaching makes this so generally impossible. "Promotion should not depend upon aggressiveness in cultivating friendships of those in authority, popularity with students or alumni, capacity for routine administrative work, or the personal favor and persistence of the head of the department." Character, personality, ability and reputation in the world of scholars should be the determining factors. Uniformity of standards in the different departments is highly desirable—the prevailing systems of indefinite tenure and recommendation by department heads tend to make as many different standards within a single university as there are heads. Each man's case should automatically come up for consideration at fixed intervals and at these times he should be given an opportunity to present such evidence of fitness for promotion as he may feel he has to offer. The conclusions as to his position should then be clearly stated to him.

8. General faculty status.

The faculty should be the supreme academic body. There should be more team-work and cooperation throughout. These men should have a voice and vote in determining the general educational policies. Fear need not be entertained that they will be too zealous or aggressive in the presence of older men whose judgments they have learned to respect. They wish to feel themselves a vital part of the institution and not mere employees. They wish to learn about these matters so that they too can give them intelligent consideration, get a view of their work in its broader aspects and relations, and receive some systematic training for the duties and responsibilities of higher positions. They have no desire to displace the older men—nor even to intimate that younger men have a great many new and invaluable ideas—but they do feel that a gain may come to an institution in preventing an attitude of settled convictions and consequent lack of further interest in its problems, by injecting a constant stream of fresh blood. To counterbalance their lack of academic experience (after seventeen years as students and teachers) they offer an "idealism which has not been too rudely shaken."

9. Department status.

One of the tragedies of life is the way we are continually closing the doors behind us and forgetting the lessons which our experiences should have taught us. Nowhere, in this study, has this fact appeared more clearly than in the delicate matter of department organization. It is well, therefore, to listen to the voice of our composite assistant professor on this subject: "The assistant professor should have a voice and vote in all departmental matters as a matter of right and not merely as a concession of the head of the department." "I regard a democratic organization of the departments, with full discussion of concrete problems of instruction, as of the highest importance. Without it proper cooperation of different instructors can not be obtained. It indirectly contributes to an intelligent discussion of general educational problems in faculty meetings." "The president to be the head of each department and to see that the men in all departments have uniform treatment." "The organization at ——, of departments with heads having large powers, is prejudicial to professors and assistant professors who are not department heads. A democratic organization of departments would be much more healthy—less immediately efficient but sounder in the long run."

In a democratic society the presence of a privileged class, or of one a considerable portion of which feels itself deprived of natural participation in affairs with which it is vitally concerned, is not wholesome. The solution of this vexed problem, already reached and long in satisfactory operation, at one of our leading institutions, seems to be a democratic departmental organization, having a

chairman, of strictly limited powers, on temporary appointment to the post.

10. Salary.

A general increase of salary in this rank is an imperative necessity; sufficient evidence of this has been presented. The cost of living has increased 50 per cent. in the period of teaching service of these men,[5] the requirements for promotion to the rank are much higher than they were twenty years ago, but there has been little change, on the whole, in the average rate of compensation. The gap between the salary of the assistant professor and that of full professor has, furthermore, greatly increased, thus adding to the difficulties of the former; for the compactness of the university community is well known. By taste, training, ability, aims and aspirations, all belong to one social class, with practically similar demands and obligations.

The institution, as well as the men, is loser by the present low standard, as a low mental tone is induced by worry; there is much loss of time in earning the necessary supplemental income, not to speak of the unfortunate dissipation of interest and energy; there is prevention of growth and development; save for single men the salaries are inadequate to provide books, necessary equipment, travel, attendance at meetings of learned societies and associations, or to permit the taking of a sabbatical year. In this latter regard, a sabbatical half-year on full pay is urged. The inadequacy of the salaries is driving many good men from the profession. "So much is this true that I am now seriously debating whether to resign now, and practise my profession, or to wait another year for a possible call to some other place." Or this, from a letter of one who had already resigned before the questionaire reached him: "While I would rather teach than do anything else, and expect to continue in that work, it must be along clinical lines, and my living must come from my practise. In other words, teaching *per se*, particularly in the fundamental sciences, is a very much underpaid profession—certainly not sufficient for the support of two persons with the possibility of additions."

A definite and adequate salary scale is a bitter necessity. Parenthetically it may be stated that an average readjustment of 3 per cent. of the total annual budget would probably suffice to relieve the situation in this rank.

[5] See "Bradstreet's," December 9, 1899, and November 13, 1909.

In summing up the aspirations of these men, I can do no better than to quote the words of the late President Canfield:

The three controlling desires of every normal man seem to be:

First, to live. Not merely to exist. Almost any one can exist in these days and especially in this country of ours. Mere existence is so easy and so common that a failure to secure this becomes noteworthy: the starvation of a single person in a population of nearly eighty millions becomes at once such an item of news that it is wired from one end of the country to the other and is commented upon by the daily press under special headlines. But the normal man desires something more than existence. He desires to live, in the sense that he wishes his fair share of those things which give color and meaning to his century. His home must be more than a mere shelter; it must be convenient and attractive and satisfying. His clothing must be such as to spare him the unfavorable comment of his fellows. Steam and electricity must minister to him, directly or indirectly. The current press must be at his reasonable command. Of libraries and art galleries and museums he must have the privilege of use, and his necessary labor must not deprive him of the opportunity of enjoying that privilege. He must be able to make his house a home by adding a hearth—and there is no hearth for a man but the heart of a woman. In a word, he must be able to live as a breadwinner and husband and father and good citizen ought to live. This is not only his own right, but the rightful demand of the welfare of the entire community.

Second, to be a man among men. He is not to be content while he remains unrecognized and unknown. He is not simply a unit to be counted, but a man to be weighed and reckoned with. He wishes to stand shoulder to shoulder with his fellows, to look level in the eyes of other men with a sense of equality and power, to feel that his experience and his observation and his resulting opinions are of value to the world and the value is recognized, that men hesitate as to certain undertakings until they know where he stands. He will not admit that he is only a fraction of a man, but insists that he is at least one of the full integers which make up the sum of life. He is not to be a flint that never strikes fire. His nature desires and demands the esteem and the regard and even the affection of his fellows.

Third, to do that which will endure. He will have no part in oblivion, he is unwilling to be forgotten, he can not abide the thought that his work is to perish, that all that to which he has given his time and strength and thought and power comes to an end simply because his body dies. He wishes to project his temper and his purpose and his plans into the future, to find in this way and even here the beginnings of immortality, so to labor that at least a part of his finite product may be worthy to be woven in and in with the divine plan and thus become lasting and infinite.

GUIDO H. MARX

STANFORD UNIVERSITY

(To be continued)

THE ELEVENTH INTERNATIONAL CONGRESS OF GEOLOGISTS, STOCKHOLM, 1910

RESPECTING the progress of the arrangements for this congress, which is to be held in Stockholm, August 18–25, the secretary-general of the congress has given the following information (February, 1910):

The deliberations of the congress will principally concern the discussion of the following questions:

1. *The Geology of the Precambrian Systems.*—The discussion is divided into the debate of the following special questions: (*a*) To what extent can it be proved that the characters of Archean rocks are due to a deep-seated metamorphosis? and (*b*) The principles of a classification of the Precambrian formations, especially as to what extent a classification after age, of local or universal importance, can be carried out. The following gentlemen have hitherto held out short introductory lectures for this discussion: F. D. Adams, Ch. Barrois, F. Becke, U. Grubenmann, J. F. Kemp, A. C. Lane, J. J. Sederholm and P. Termier.

2. *The Abrupt Appearance of the Cambrian Fauna.*—Messrs. Ch. Lapworth, G. F. Matthew, A. Rothpletz, C. D. Walcott and J. Walther have promised contributions on this subject.

3. *The Changes of the Climate Since the Maximum of the Last Glaciation.*—As an introduction to this discussion three Swedish scientists (G. Andersson, G. De Geer and R. Sernander) published last spring comprehensive descriptions of matters of fact observed in Sweden, which are conclusive for the explanation of the postglacial climatic deviations in that country. These three essays were sent to a considerable number of foreign scientific men that have occupied themselves with the question of postglacial climate, and these gentlemen were at the same time requested to cooperate in an international discussion of this problem. The Swedish Committee desires the cooperation in this international debate in such a manner that from each country but one report on the postglacial climatic deviations observed there should be sent in. In consequence of this invitation already several treatises on the said subject have been sent in and scientists from the following countries have hitherto promised their cooperation: Austria, Belgium, Canada, the Cape Colony, Denmark, Egypt, England, Finland, France, Germany, Hungary, India, Italy, Norway, Russia, Sweden, Switzerland. Reports on the arctic and antarctic regions have also been received.

All the treatises, sent in from the different countries, will be collected in an autonomous work: *The changes of climate since the maximum of the last glaciation.* This publication, which will probably be ready in the course of the month of April, will form the basis of the coming discussion. This work will be sent free of cost to the contributors. Besides, it will also be procurable, at a price not yet fixed, from the publisher, "Generalstabena Litografiska Anstalt," Stockholm 3.

4. *The Iron Ore Resources of the World.*—In the beginning of 1908 the committee of the congress sent to the national geological institutions and to the mining geologists in the different states invitations to take part in an exhaustive investigation of the above question. This request has everywhere met with so much attention that, at present, reports from nearly all the iron-ore producing countries of the world have been received which will be collected in one work: "The Iron-ore Resources of the World." This publication, consisting of

about 900 pages in quarto with numerous plates and illustrations in the text and accompanied by an atlas of 40 map-sheets, will shortly be ready. It will be sent free of cost to the governments of the cooperating states and to the collaborators, and it will also be procurable from the above-mentioned publisher at a price of £3. This work will form the basis for the discussion at the congress of the possibilities of the future iron and steel industry to procure the raw material.

5. *The Geology of the Polar Regions.*—This subject will be treated in a series of special lectures, of which the following have hitherto been advised:

H. Jarner: "The Geological Results of the *Danmark* Expedition to Northeastern Greenland."

A. G. Nathorst: "The Climatic Testimony of the Fossil Floras in the Polar Regions."

J. F. Pompeckj: "The Jurassic Deposits of the Arctic Region."

N. V. Ussing: "The Eruptive Area of Tlimausak—Western Greenland."

Besides, one of the geologists of the last British Antarctic Expedition will give a report on the geological results of this expedition.

In connection with the discussion of polar geology there will be an exhibition arranged of the geological collections brought home by Swedish expeditions from the arctic and antarctic regions.

The debates of the congress will principally relate to the discussion of the above questions. Isolated lectures, of which the committee has been informed, will be placed in one of the following sections:

1. General and regional geology. Tectonic matters.
2. Petrography and mineralogy.
3. Stratigraphy and paleontology.
4. Quaternary formations. Recent glaciers.
5. Applied geology.

In connection with the congress the following excursions will be arranged:

A. Excursions before the Congress.

1. Spitzbergen, July 25 to August 17. Leader: G. De Geer.
2. Norrland (over-thrusts, eruptives, iron ore fields), July 27 to August 17. Leaders: A. G. Högbom, Hj. Lundbohm and P. J. Holmquist.
3. Iron-ore fields of Gellivare and Kirunavaara, August 6–17. Leader: Hj. Lundbohm.
4. Quaternary geology of the Torneträsk, August 6–17. Leader: O. Sjögren.
5. The Alps of Sarek, July 27 to August 17. Leader: A. Hamberg.
6. Quaternary geology of Angermanland and Jämtland, August 9–17. Leader: A. G. Högbom.
7. Peat-moors of Närke, August 10–16. Leader: L. v. Post.

B. Excursions during the Congress.

Several excursions of one day, principally in the environs of Stockholm.

C. Excursions immediately after the Congress.

1. The Archean rocks of middle Sweden, August 26 to September 4. Leaders: A. G. Högbom, P. J. Holmquist, A. Gavelin and H. Hedström.
2. Silurian deposits of Gotland, Dalarne and Västergötland, August 25 to September 6. Leaders: H. Munthe, H. Hedström, C. Wiman and E. Warburg.
3. Quaternary geology of southern Sweden, August 26 to September 8. Leaders: G. De Geer, H. Munthe and A. G. Nathorst.
4. Ore fields of middle Sweden, August 26 to September 6. Leaders: Hj. Sjögren, W. Petersson and H. Johansson.
5. Morphology of middle Sweden, August 26 to September 4. Leaders: O. Nordenskjöld and S. De Geer.
6. Plant-containing mesozoic deposits in Skåne, August 26–29. Leader: A. G. Nathorst.
7. Cretaceous system in Skåne, August 25–29. Leader: A. Hennig.

D. Excursion in Skåne after the conclusion of group C.

Silurian deposits, September 7–13. Leader: J. C. Moberg.

In the beginning of March the second circular of the congress will be sent out, containing full particulars about the excursions and a statement of costs, etc.

All correspondence relating to the congress to be addressed to the secretary-general, Professor J. G. Anderson, Stockholm 3.

Synchronous with the Congress of Geologists and in intimate connection with it "The Second International Agrogeological Conference" will be held in Stockholm. The secre-

tary of the same is Dr. H. Hesselman, Valhallavägen 25, Stockholm.

THE BROOKLYN BOTANIC GARDEN

A Brooklyn Botanic Garden is now being established by the City of Greater New York in cooperation with the Brooklyn Institute of Arts and Sciences. Between twenty-five and thirty acres of land, south of the museum building of the institute in Brooklyn, and separated from Prospect Park by Flatbush Avenue, have been set apart for the purposes of the garden, and are now being surveyed and graded. A laboratory building for purposes of investigation and instruction, together with a range of experimental and public greenhouses, will be constructed during the coming summer and autumn. For this purpose the City of New York has appropriated $100,000. In addition to this, friends of the garden in Brooklyn have subscribed $50,000 as an endowment, the income of which is to be used for the purchase of equipment. It is intended to make the new garden not only a center of research, but also to give instruction to both elementary and advanced classes in botany, and cooperate in every feasible manner with the botanical work of the public and private schools of the Borough of Brooklyn. Dr. C. Stuart Gager, professor of botany in the University of Missouri, has been appointed director of the garden and will enter on his duties the first part of July. A scientific staff will be gradually assembled as soon as the buildings are ready for occupancy.

SCIENTIFIC NOTES AND NEWS

Dr. George W. Hill, of Nyack, N. Y. and Professor E. B. Wilson, of Columbia University, have been elected foreign members of the Brussels Academy of Sciences.

The Rumford Committee of the American Academy has recently made the following grants in aid of research: To Professor Joel Stebbins, $350, in aid of his research with the selenium photometer. To Professor W. W. Campbell, $125, in furtherance of the research on the polariscopic study of the solar corona by means of a Hartmann photometer. To Mr. Frank W. Very, $50, for the purchase of photographic glass plates of the spectrum by Higgs. To Professors C. E. Mendenhall and Augustus Trowbridge, $250, in aid of their research on the effect of ether drift on the intensity of radiation. To Professor C. E. Mendenhall, $250, in furtherance of a research on the free expansion of gases. The committee has also made a grant of $250 to Professor Gilbert N. Lewis in aid of preparation of abstracts for publication in light and heat for the forthcoming International Physico-chemical tables.

Professor E. G. Conklin, of Princeton University, has been appointed to represent the National Academy of Sciences at the Zoological Congress at Gratz, Austria, and at the meeting of the International Association of Academies at Rome, Italy.

The American Philosophical Society has appointed Professor E. G. Conklin, of Princeton University, a delegate to the eighth International Zoological Congress at Gratz, Austria, August, 1910; Professor George L. Goodale, of Harvard University, a delegate to the International Congress of Botanists at Brussels, May, 1910, and Professor Frederick W. Putnam, of Harvard University, a delegate to the Congress of Americanists in the City of Mexico in September, 1910.

Professor Sir J. J. Thomson has been nominated to represent Cambridge University at the celebration in October, 1910, of the centenary of the University of Berlin.

The Biological Society of the Massachusetts Institute of Technology gave a dinner in honor of Professor Wm. T. Sedgwick, on March 17, prior to his departure for Europe. Speeches were made by President Maclaurin, Professor Talbot and Professor Porter, and Professor Sedgwick replied.

Dr. Henry Fairfield Osborn, president of the American Museum of Natural History, and Dr. Charles W. Dabney, of the University of Cincinnati, are among those who have been chosen as electors for the Hall of Fame of New York University.

PROFESSOR BASHFORD DEAN, Columbia University, has recently been decorated by the French government chevalier de la légion d'honneur in recognition of his services to zoology in France.

DR. H. A. MIERS, F.R.S., principal of the University of London, has been elected a member of the Athenæum Club for "eminence in science."

DR. C. LLOYD MORGAN, F.R.S., for upwards of twenty years principal of University College, Bristol, first vice-chancellor of the university and now professor of psychology and ethics, has received a presentation from the staff and students of University College and friends. The gifts consisted of several substantial pieces of plate and £200 worth of books.

THE Marquis Cappelli has been appointed president of the International Institute of Agriculture at Rome, to succeed Count Faina, who has resigned owing to diplomatic troubles about minor appointments under the institute.

THE following officers of the Pellagra Investigation Committee have been selected: *Chairman,* Sir T. Lauder Brunton; *vice-chairman,* Dr. F. M. Sandwith; *honorary secretary and treasurer,* Mr. J. Cantlie; *advisory subcommittee,* Mr. E. E. Austen, Professor E. C. Bayly, Sir William Leishman, Dr. J. M. H. MacLeod, Sir Patrick Manson, Sir John McFadyean, Dr. F. W. Mott and Professor Ronald Ross. The *field-workers* will be Dr. Louis W. Sambon, of the London School of Tropical Medicine, and Captain J. E. Siler, with Mr. Arthur Dawson-Amoruso and Mr. G. C. C. Baldini as assistants.

DR. H. H. BUNZEL, assistant in physiological chemistry at the University of Chicago, has been appointed biochemical expert of the Bureau of Plant Industry in the U. S. Department of Agriculture.

DR. J. H. CREIGHTON, professor of philosophy at Cornell University, will have leave of absence next year. His course will be taken by Dr. G. H. Sabine, of Stanford University.

PAST ASSISTANT SURGEON C. H. LAVINDER, of the Public Health and Marine Hospital Service has been sent to Milan and other places in Italy for the purpose of making an investigation into the origin and prevalence of pellagra and into the measures being taken to combat the disease.

MR. W. G. BATEMAN, lately instructor in chemistry in Stanford University, has sailed for China to take up his work as professor of chemistry in the University of Tiensin.

DR. V. FRANZ, assistant in the biological station in Heligo Land, has been appointed head of the department in the Frankfort Neurological Institute.

PROFESSOR W. M. FLINDERS PETRIE has accepted the presidency of the Hampstead Scientific Society, in succession to Sir Samuel Wilks, F.R.S., who has resigned.

DR. JOHN M. COULTER, head of the department of botany, was the orator at the seventy-fourth convocation of the University of Chicago, on March 15. The subject of his address was "Practical Science."

DEAN F. E. TURNEAURE, of the College of Engineering of the University of Wisconsin, reported at the eleventh annual meeting of the American Railway Engineering and Maintenance of Way Association at Chicago last week on the work of the special committee on the effect of high speed and weight of trains on steel and iron bridges, of which he is chairman.

DR. ELLSWORTH HUNTINGTON, of Yale University, on February 26, lectured before the students of Denison University on "The Untamed Inner Border of Palestine."

THE Bakerian lecture of the Royal Society was delivered on March 17 by Professor J. H. Poynting, F.R.S., and Dr. Guy Barlow, on "The Pressure of Light."

AMONG the lectures to be given at the Royal Institution, London, after Easter, is a course of three on the mechanism of the human voice, by Dr. F. W. Mott, F.R.S., Fullerian professor of physiology; Professor C. J. Holmes will give two lectures on heredity in Tudor and Stuart portraits; and Major Ronald Ross, F.R.S., two lectures on malaria. The Tyndall

lectures on electric heating and pyrometry will be given by Professor J. A. Fleming.

Dr. Alfred Tuckerman, historian for the American Association for the Advancement of Science, requests us to state that if members of the American Chemical Society who have had correspondence with the late Dr. Charles B. Dudley will send it to him at the Smithsonian Institution, Washington, D. C., it will be safely preserved and will be accessible to those interested.

The Rev. Carr Waller Pritchett, formerly director of the Morrison Astronomical Observatory and president of Central College and Pritchett College, Missouri, died on March 18, at the age of eighty-seven years.

Professor Edward A. Bowser, for thirty-three years professor of mathematics and engineering at Rutgers College, died at Honolulu, at the age of sixty-five years.

George Willis Kirkaldy, an entomologist, known for his work in hemipterology, died at San Francisco, on February 2, in his thirty-sixth year.

Dr. E. P. Wright, for many years professor of botany in Dublin University, has died at the age of seventy-six years.

At the general meeting of the American Philosophical Society in April, 1909, a committee on South Polar exploration was authorized. The resolutions in reference to the matter were sent to all the scientific bodies naturally interested in such exploration, and were supported very widely by them. Later the following were appointed members of this committee: Edwin S. Balch, Henry G. Bryant, Hermon C. Bumpus, Wm. Morris Davis, George W. Melville, Henry F. Osborn and Charles D. Walcott. The committee has been actively at work to promote the exploration of the South Polar region by an American expedition under the auspices of the government. The Navy Department is actively interested in the matter, and it is hoped that the expedition will be definitely authorized before long.

Sixty committees on the prevention of tuberculosis in various parts of the state of New York met at Albany last week. At the session on March 18, the Hon. Joseph H. Choate presided and among those making addresses were Dr. Simon Flexner, director of the Rockefeller Institute of Medical Research, and Dr. E. L. Trudeau.

The summer meeting of the American Institute of Chemical Engineers will be held at Niagara Falls, N. Y., from June 22 to 24. A prominent feature of the meeting will be visits to the interesting chemical industries in this locality. An important program of papers is being arranged for by the committee on meetings.

A Physics Club at Philadelphia has been organized with Professor George A. Hoadley, of Swarthmore College, as president and Dr. Guy W. Chipman, of the Friends' Central School, as secretary and treasurer. There are at present forty-three members. At the fourth meeting held at the Central High School, on March 11, Dr. Paul R. Heyl, of the Central High School, presented a paper on the magnetic storm of September 25.

The eighth International Physiological Congress is to be held at the Physiological Institute of the University, Vienna, from September 27–30 next.

The British Medical Association will hold its seventy-eighth annual meeting in London, July 26 to July 29. The president's address will be delivered on July 26 and the sections will meet on the three following days. The president of the association is Sir William Whitla and the president-elect Mr. H. T. Butlin.

The *Medical Record* states that the Forsyth Dental Infirmary is soon to be incorporated in Boston as a result of a donation of $2,000,000 made by Mr. Thomas A. Forsyth, of that city. The infirmary is to be located in Hemenway Street in the Back Bay, is to be thoroughly equipped and manned for modern dental surgery, and is to be free to any child under sixteen years of age. The purpose of the clinic is to give free care of the teeth to every child in Boston.

AMONG the recent gifts to the U. S. National Museum are a series of minerals from Cobalt, Ontario. These include a specimen of niccolite which is an arsenide of nickel and shows the rich metallic luster so characteristic of all nickel ores. Another is a fine specimen of breithauptite, which is a combination of nickel and antimony, with strings of native silver in a matrix of calcite. The slender veins of these two metallic ores wandering irregularly through the white limestone are most attractive. With these there is also from the same locality a specimen of the mineral, known as smaltite which in composition is a combination of cobalt and arsenic. It has a white silvery appearance and is a good cabinet specimen.

THE twenty-first session of the Biological Laboratory of the Brooklyn Institute of Arts and Sciences located at Cold Spring Harbor, Long Island, will be held for six weeks beginning Wednesday, July 6. The courses offered comprise field zoology by Drs. H. E. Walter and C. B. Davenport; bird study by Mrs. H. E. Walter; comparative anatomy by Drs. H. S. Pratt and A. A. Schaeffer; general embryological and microscopical technique by Miss Mabel Bishop, of Goucher College; cryptogamic botany by Dr. D. S. Johnson, of Johns Hopkins University, and Mr. H. H. York; ecology by Dr. H. S. Conrad, of Grinnell College. For the first time a course for teachers on the principles of agriculture is offered under the direction of Professor H. H. Laughlin, of Missouri State Normal School, at Kirksville. The usual facilities for beginning investigation under the direction of the instructors are offered and a limited number of tables and private rooms are available for investigators. Those who desire to make use of the facilities of the laboratory for investigation may address the director, C. B. Davenport, Cold Spring Harbor, N. Y., from whom announcements may be obtained.

THE *Geographical Journal* is informed that a scientific expedition to Colombia is being organized at Neuchâtel, under the auspices of the Société Helvétique des Sciences Naturelles, the leader being Dr. O. Fuhrman, professor of zoology at Neuchâtel University. It is hoped that a start will be made in July next, and the main objects kept in view will be the study of the fauna of the lakes and rivers of central Colombia, as well as the parasitic flora, but geological and geographical observations are also contemplated. Dr. Fuhrmann will be accompanied, as botanist, by Dr. Mayor, of Neuchâtel. The Magdalena will be ascended from Baranquilla to Puerto Berrio, whence the party will proceed to Medellin. From this and other centers excursions will be made to various parts of the central Cordillera and the region of the Cauca, the travelers afterwards turning their attention to the Paramos of the eastern Cordillera, and making excursions in various directions from Bogotá. Halts will also be made later at Honda and Puerto Berrio, during the return journey to the coast.

UNIVERSITY AND EDUCATIONAL NEWS

MRS. HELEN HARTLEY JENKINS has given the University and Bellevue Hospital Medical College $100,000 to endow the Marcellus Hartley professorship of medicine.

MR. CHESTER W. LYMAN, of New York, has given $5,000 to the Sheffield Scientific School of Yale University for a lectureship on the subject of water-storage conservation to be known as the Chester W. Lyman lectureship in memory of the donor's father, who was for many years professor of physics and astronomy in the Sheffield Scientific School.

A FRIEND of the Allegheny Observatory has endowed a fellowship in astronomy at that institution. The fellow is to receive $500.

IT is reported in the daily papers that Mr. John D. Rockefeller has given $150,000 to erect buildings for the American College for Girls at Constantinople.

MR. W. H. LEVER has offered to give to the University of Liverpool, property of the value of £84,000, which appears to have been the receipts resulting from a libel suit instituted against the London *Daily Mail* by Messrs. Lever Brothers.

The Duke of Portland has promised £2,000 towards establishing a chair of mining at Nottingham University College.

The trustees of Cornell University have decided to limit the work in the medical department at Ithaca to one year in the future instead of two, as has been the custom since the school was founded.

Of thirty-one elections to the Phi Beta Kappa honorary fraternity at Cornell University, nineteen are women, and of twenty-seven elections at the University of Illinois twenty are women.

Closer relations are being established between the College of Physicians and Surgeons, Columbia University, and the Mt. Sinai and German Hospitals in New York. The following members of the staffs of the hospitals have received appointments in Columbia University. From Mt. Sinai Hospital Drs. Brill, Libman, Gerster and Berg, and from the German Hospital, Drs. Kammerer, Stadtmüller and Hensel.

Dr. George P. Burns, of the University of Michigan, has been called to the chair of botany at the University of Vermont.

Mr. Leonard Doncaster, lecturer in the University of Birmingham, known for his work in zoology and especially in heredity, has been elected a fellow of King's College, Cambridge.

Mr. William Ray, Rhode scholar from Adelaide at Oxford, has been elected to the Philip Walker studentship at Oxford, for research in pathology. The fellowship is of the value of £200 a year for three years.

Dr. G. Haberlandt, of Graz, has been called to the chair of botany at the University of Berlin, vacant by the retirement of Professor Schwendener.

Dr. Karl Uhlig, of Berlin, has been called to the chair of geography at Tübingen, to succeed Professor K. Sapper.

Dr. Alfred Grund, of the University of Berlin, has been made professor of geography in the German University of Prague.

Dr. Ernst Meumann, of Halle, has been called to the chair of philosophy at Leipzig, vacant through the death of Professor Max Heinze.

DISCUSSION AND CORRESPONDENCE

THE DIRECTORY OF AMERICAN MUSEUMS

The Directory of American Museums of Art, History and Science, which is being prepared by the American Association of Museums, is nearly ready for the printers, and all museums which have not already returned information regarding their collections are urged to communicate at once with the undersigned.

The data desired include a list of the staff; an enumeration of the nature and extent of the collections, with comments on the more important material; a statement of the sources and amount of the financial support; particulars regarding the building, including the amount of floor space occupied; the scope and purposes of the museum; information concerning the museum library and publications, if any; and the times and conditions upon which the museum is open to the public, with statistics of attendance, if available.

The cooperation of the American museums is earnestly requested in order that the directory may be as complete as possible.

Paul M. Rea,
The Charleston Museum, *Secretary*
Charleston, S. C.

A QUEER FISH

Some newspapers have connected me with the statement that a specimen said to be a fish with four legs was caught in Brazil. Permit me to say that the particular specimen has no legs and is not a fish.

C. H. Eigenmann

SCIENTIFIC BOOKS

Lehrbuch der Protozoenkunde. Eine Darstellung der Naturgeschichte der Protozoen mit besonderer Berücksichtigung der parasitischen und pathogenen Formen. Zweite Auflage der "Protozoen als Parasiten und Krankheitserreger." Von Dr. F. Doflein.

Pp. x + 914, mit 825 Abbildungen im Text. Jena, Gustav Fischer. 1909. M. 24, Geb. 26.50.

The rapid development in recent years of the science of protozoology to a position coordinate with bacteriology is reflected in the enormous increase in the literature dealing with the Protozoa. The *Archiv für Protistenkunde* founded by Schaudinn in 1902 is now in its eighteenth volume. For the year 1890 the *Zoological Record* lists 109 titles under protozoa, for 1900 there are 167, and 1905 no less than 522, the high-water mark to date.

This activity in research has not only brought to light countless details of structure, and increased many fold the categories of life-histories, but it has also complicated rather than simplified our general notions regarding the cytology of protists and the primitive processes of reproduction. The Protozoa are no longer to be regarded as simple organisms. It has likewise raised many hotly contested questions such as the life history and relationships of the trypanosomes, the relationships of the spirochætes and the occurrence and meaning of chromidia. It has brought to light not a few problematical protists, seen for example in those structures associated with such diseases as small-pox, measles, scarlet fever, epithelioma contagiosum and trachoma which Prowazek has grouped together as Chlamydozoa, as well as other less notorious organisms which are with difficulty allocated in existing categories, though beyond all question to be regarded as protozoa.

The stupendous task of assembling, coordinating and sifting this ever-increasing flood of protozoological literature into a "Lehrbuch" would be attempted only by a German, and even Dr. Doflein admits that he would not have undertaken the three years' "mühsamer Arbeit" had he clearly foreseen the magnitude of the task and the burden of reviewing the literature.

The author's treatment of this overwhelming mass of data has been facilitated by his own incursions into the different fields of research here represented. His treatment of contested points is wisely conservative and objective, though one is disappointed in not finding a full and critical discussion of the claims of the Chlamydozoa for admission to the category of protozoan organisms and regrets their summary dismissal.

The account of the sexual reproduction of *Trypanosoma lewisi* in the rat louse as described by Prowazek is regarded by Doflein as hypothetical throughout, resting upon too few observations, and these apparently upon abnormal stages. It remains to be seen if later work will not confirm the existence of a sexual cycle in an insect host. Schaudinn's account of the complicated life histories of the blood parasites of the owl is, perhaps more justly, dismissed as improbable in the light of the work of Novy and his collaborators.

The point of view from which the book is written is most commendable, to wit, to bring the results of investigations upon parasitic and pathogenic protozoa into correlation with our general knowledge of the natural history of the group. While the parasitic protozoa are given a large place in the systematic part of the text even to the exclusion of others equally interesting and important but non-pathogenic, the main outlines of the work and the general discussions are not thus limited but are conceived and elaborated along the broadest lines so that the work is of value to all who deal with protozoa or with the biological problems which they may elucidate.

The introductory treatment of the general morphology, physiology, reproduction and ecology of the groups forms the first third of the volume, while the remainder contains a systematic presentation of the phylum protozoa by orders and families carried to genera and species in many cases of important parasitic and pathogenic forms. Special chapters on the parasitism and pathological significance of the different groups are interspersed in this section.

The Flagellata are treated in 142 pages, the Rhizopoda in 132, the Sporozoa in 218 and the Ciliata in 47. With all due regard to the scientific, economic and social value of the pathogenic phase of protozoology, to the limitations of a single volume, to the relative de-

mand for and interest in the information regarding the different groups, and to their biological significance, many users of Dr. Doflein's book will doubtless agree with the reviewer that the non-pathogenic groups are all too inadequately represented. The Ciliata are especially unfortunate in coming up last for presentation in a volume rapidly approaching a thousand pages. One feels that the extensive and important recent work on the Radiolaria is very incompletely presented in the 18 pages mostly consisting of a perfunctory list of radiolarian families. In fact a new edition of Bütschli's Thierreich monograph is sorely needed to make possible a well-coordinated critical review of the whole group of Protozoa and this is a task which in the present state of the science can only be undertaken by a group of specialists. All protozoologists, biologists and pathologists will be profoundly grateful to the author for the book even with these minor limitations. It will also prove a stimulus to further research and greatly facilitate it. Problems requiring further elucidation are continually suggested in its pages.

The book is, beyond all question, the best illustrated work that has come from Fischer's famous press. This is due to the wise selection of figures, the inclusion of many original sketches made especially for the work, and to the uniformly careful preparation of the drawings, as well as to the high degree of technical skill in the reproduction. The only drawback is the reflection from the highly glazed paper which is very trying to the eyes.

An English translation of the work, revised to date, is in preparation by Col. Leslie in conjunction with Dr. Doflein. This will be especially welcome to English readers, since it makes the work available for instruction in academic and medical classes.

The book is fittingly dedicated to "meinem lieben Lehrer und Freund Richard Hertwig in Verehrung und Dankbarkeit," and comes logically from the laboratories at Munich, the foremost center in the world for protozoological research along comprehensive lines.

Charles A. Kofoid
University of California

Allen's Commercial Organic Analysis. Volume I. Introduction, Alcohols, Yeast, Malt Liquors and Malt, Wines and Spirits, Neutral Alcoholic Derivatives, Sugars, Starch and its Isomerides, Paper and Paper-making Materials, Vegetable Acids. By Henry Leffmann and W. A. Davis, editors, and E. F. Armstrong, J. L. Baker, G. C. Jones, E. Schlichting and R. W. Sindall, contributors. Fourth edition, entirely rewritten. Philadelphia, P. Blakiston's Son and Co. 1909. Pp. x + 576. Price $5.00.

It is eleven years since the last American edition of this well-known work was published. When we consider the very rapid advances which have been made in this field during recent years and also that the third edition was prepared so hastily as to prevent a thorough revision, the need of a thorough rewriting of the whole book is evident. The revision has been very thorough and a large amount of new material has been added.

No one individual can be thoroughly familiar by personal experience with the great variety of analytical methods presented in a book of this kind and the editors have very wisely secured the help of several expert chemists for the preparation of different sections of the book. The introduction (83 pages) treating of general methods of analysis and the determination of physical constants is by William A. Davis; Methyl and Ethyl Alcohol (47 pages), by G. C. Jones; Malt and Malt Liquors (32 pages), by Julian L. Baker; Wines and Potable Spirits (39 pages), by G. C. Jones; Yeast (21 pages, wholly new), by E. Schlichting; Neutral Alcoholic Derivatives, as Ether, Esters, Aldehydes, Chloroform, etc. (57 pages), by Henry Leffmann; Sugars, Analysis of Urine, Starch, Dextrin, Flour, Bread, Cellulose, etc. (180 pages), by E. Frankland Armstrong; Paper and Paper-making Materials (20 pages, new), by R. W. Sindall and Acid Derivatives of Alcohols, as acetic acid, vinegar, oxalic, succinic, malic, tartaric and citric acids (83 pages), by Henry Leffmann.

The book is one which should be in every chemical library and which no chemist engaged in the examination of foods can afford to be without.

W. A. Noyes

SCIENTIFIC JOURNALS AND ARTICLES

The Journal of Biological Chemistry, Vol. VII., No. 3, issued February 26, contains the following: "The Optical Inactivity of Allantoin," by Lafayette B. Mendel and H. D. Dakin. The generally accepted formula for allantoin contains an asymmetric carbon atom. Yet examination of the substance from a variety of sources showed that it is optically inactive. Evidence is offered indicating that the phenomenon is due to tautomeric change. "The Mechanism of the Oxidation of Glucose by Bromine," by H. H. Bunzel. Experiments are described which support the view that glucose forms two series of salts: the first in which it dissociates into metal and negative glucose ions ($C_6H_{11}O_6^-$); the second, in which it dissociates into positive glucose ions ($C_6H_{12}O_6^+$) and an acid ion. Positive glucose ions are oxidized quantitatively to gluconic acid and an equation is developed showing the velocity of the reaction. "The Purine Metabolism of the Monkey," by H. Gideon Wells. The liver of the monkey resembles that of lower mammals in containing a uricolytic enzyme. The liver also contains xanthine-oxidase; the liver and other viscera contain nuclease, adenase and guanase. "The Effects of Castration on the Metabolism," by Francis H. McCrudden. An experimental study on dogs, the results of which do not confirm the view that castration is followed by a retention of material, especially mineral elements. "Chemical Analysis of Bone from a Case of Human Adolescent Osteomalacia," by Francis H. McCrudden. Bone from osteomalacia contains more magnesium and sulphur, less calcium and phosphoric acid than normal: the increase in the former is far greater than the decrease in the latter. "The Influence of Dietary Alternations on the Types of Intestinal Flora," by C. A. Herter and A. I. Kendall. Extended experiments on monkeys and cats show that an abrupt change from a dominantly protein diet to a dominantly carbohydrate diet is followed by alterations in the intestinal flora, in the putrefaction products in the feces and urine and in the clinical conditions. Degeneration of the proteolyzing bacteria takes place and they are substituted by acidophilic, non-protolyzing bacteria: marked reduction in putrefactive products in feces and urine occurs; a marked improvement in spirits and activity may be noted, indicating a greater sense of bodily and psychical well-being.

HALLEY ON THE AGE OF THE OCEAN

EDMUND HALLEY was a very great man. He was not only the first to predict correctly the return of a comet, that which is now known by his name, but also—before Newton had announced his results to any one—arrived at the conclusion that the attraction of gravitation probably varied inversely as the square of the distance. While these and other important achievements of his are well known, it seems to have been forgotten that Halley devised a method of determining the age of the ocean from chemical denudation. Indeed, I find no mention of Halley in the indices of some of the most authoritative works on geology and geochemistry, while it is evident that neither Mr. T. Mellard Reade[1] nor Mr. J. Joly[2] were aware of a predecessor in this important field. It was almost by accident that I came across Halley's paper read before the Royal Society in 1715, extracts from which are given below.

Halley recognized that the method as he proposed it was almost impracticable, but writing as he did twenty-eight years before Lavoisier's birth, he could hardly have guessed that accurate analyses of river waters, whose solvent action he so clearly describes, would ever become not merely possible but easy. It is very interesting to note that Halley's reasoning is strictly "uniformitarian" while he recognized the tendency involved to a maximum estimate.

Subject to this same limitation (extended to other features besides an original saltness of the sea), Mr. Joly's method of determining the rate at which the accumulation of salt in the ocean takes place from the analysis of

[1] "Chemical Denudation in Relation to Geological Time," 1879.

[2] *Trans. R. S. Dublin*, Vol. 7, 1899, p. 23.

river waters is perhaps the most important means now available for an estimate of the antiquity of the stratified rocks, because it is the simplest and least open to question. To my thinking the fact that his train of reasoning coincided with that of the great astronomer only adds to the credit due Mr. Joly.

A great amount of work has been done of late years on the composition of river waters, much of it incited by Mr. Joly's memoir and undertaken with the purpose of improving the data for such a determination of the age of the ocean. Within a few months it will be practicable to make known the results of a revised estimate founded upon data far more ample than those at the disposition of Mr. Joly eleven years ago. Mr. F. W. Clarke is now engaged in preparing this estimate.

The subjoined extracts from Halley's paper[3] can not but interest all lovers of natural science.

On the Cause of the Saltness of the Ocean, and of the Several Lakes that emit no Rivers; with a Proposal, by means thereof, to discover the Age of the World.

There have been many attempts made, and proposals offered, to ascertain from the appearances of nature, what may have been the antiquity of this globe of earth; on which, by the evidence of sacred writ, mankind has dwelt about 6,000 years; or according to the Septuagint above 7,000. . . . This inquiry seeming to me well to deserve consideration, and worthy the thoughts of the Royal Society, I shall take leave to propose an expedient for determining the age of the world by a medium, as I take it, wholly new, and which in my opinion seems to promise success, though the event can not be judged of till after a long period of time; submitting the same to their better judgment. What suggested this notion was an observation I had made, that all the lakes in the world, properly so called, are found to be salt, some more some less than the ocean, which in the present case may also be esteemed a lake; since by that term I mean such standing waters as perpetually receive rivers running into them, and have no exit or evacuation. . . .

Now I conceive that as all these lakes receive rivers, and have no exit or discharge, so it will be necessary that their waters rise and cover the land, until such time as their surfaces are sufficiently extended, so as to exhale in vapour that water which is poured in by the rivers; and consequently that lakes must be larger or smaller, according to the quantity of the fresh they receive. But the vapours thus exhaled are perfectly fresh; so that the saline particles brought in by the rivers remain behind, while the fresh evaporates; and hence it is evident that the salt in the lakes will be continually augmented, and the water grow salter and salter. . . .

Now if this be the true reason of the saltness of these lakes, it is not improbable but that the Ocean itself is become salt from the same cause, and we are thereby furnished with an argument for estimating the duration of all things, from an observation of the increment of saltness in their waters. For if it be observed what quantity of salt is at present contained in a certain weight of the water, of the Caspian Sea, for example, taken at a certain place, in the driest weather; and after some centuries of years the same weight of water, taken in the same place, and under the same circumstances, be found to contain a sensibly greater quantity of salt than at the time of the first experiment, we may by the rule of proportion, make an estimate of the whole time wherein the water would acquire its present degree of saltness.

And this argument would be the more conclusive, if by a like experiment a similar increase in the saltness of the Ocean should be observed: for that, after the same manner as aforesaid, receives innumerable rivers, all which deposit their saline particles therein; and are again supplied, as I have elsewhere showed, by the vapours of the Ocean, which rise from it in atoms of pure water, without the least admixture of salt. But the rivers in their long passage over the earth imbibe some of its saline particles, though in so small a quantity as not to be perceived, unless in these their depositories after a long tract of time. And if, on repeating the experiment, after another equal number of ages, it shall be found that the saltness is further increased with the same increment as before, then what is now proposed as hypothetical, would appear little less than demonstrative. But since this argument can be of no use to ourselves, it requiring very great intervals of time to come to our conclusion, it were to be wished that the ancient Greek and Latin authors had delivered down to us the degree of the saltness of the sea, as it was about 2000 years ago: for then it can not be doubted but that the difference between what is now found and what then

[3] *Phil. Trans.*, Vol. 29, 1715, p. 296.

was, would become very sensible. I recommend it therefore to the society, as opportunity shall offer, to procure the experiments to be made of the present degree of saltness of the Ocean, and of as many of these lakes as can be come at, that they may stand upon record for the benefit of future ages.

If it be objected that the water of the Ocean, and perhaps of some of these lakes, might at the first beginning of things, in some measure contain salt, so as to disturb the proportionality of the increase of saltness in them, I will not dispute it: but shall observe that such a supposition would by so much contract the age of the world, within the date to be derived from the foregoing argument, which is chiefly intended to refute the ancient notion, some have of late entertained, of the eternity of all things; though perhaps by it the world may be found much older than many have hitherto imagined.

GEORGE F. BECKER

THE NAVAL OBSERVATORY: THE COMPLETION OF THE CATALOGUE OF THE WASHINGTON ZONES OF 1846–52

SHORTLY after the founding of the Naval Observatory, the superintendent, Lieutenant M. F. Maury, U. S. N., in the spring of 1846 directed the observers on the mural circle, the meridian circle and the transit instrument, when these instruments were not otherwise employed, to determine the positions of all the stars culminating above the horizon at Washington and visible with these instruments, beginning at the southern horizon and working northward. In three years 41,700 observations had been made, covering about 30° in declination. No observations seem to have been made during the next two years, but with the installation of the chronograph observing was resumed and 3,200 observations were made during 1851–2. The total number of observations discussed in forming the catalogue is 44,900.

In 1860 was published the first volume of the zones, those observed with the meridian circle in 1846. Shortly thereafter an appropriation was secured from congress for the reduction of the zone observations and Dr. B. A. Gould, of Cambridge, Mass., was secured to take charge of the work. The observations made in 1846–9, except those already published and two books of 3,400 observations which had been mislaid, were copied from the observing books on reduction sheets which were sent to Dr. Gould. The reductions were promptly made and the printer's copy returned. Several years later, 1872–3, the results sent by Dr. Gould were published under the direction of Professor Asaph Hall, U. S. N., in three volumes, as appendices to the Washington observations.

In order to facilitate the cataloguing of these zones, a list of stars to serve as zero stars was selected and added to the observing list of the 8.5-inch transit circle by Professor J. R. Eastman, U. S. N., who also had the individual observations in the four volumes previously mentioned copied on cards. The copying on one card of all the observations of the same star was commenced when work was again stopped.

This was the state of the work in 1901 when cataloguing was undertaken by the writer. A complete rereduction of the observations has not been attempted, but a systematic search has been made for all appreciable errors. In this work have been utilized a manuscript list of 2,200 corrections by Professor J. C. Kapteyn and another of 500 by Dr. F. Ristenpart, and an effort has been made to identify each star observed but once with one in the "Cape Photographic Durchmusterung," the "Cordoba Durchmusterung" or the "Bonn Durchmusterung." All single observations not thus identified are being looked up with one of the equatorials at the observatory.

The 3,400 unpublished observations of 1847–8 and the 3,200 of 1851–2 were reduced under the direction of Professor F. B. Littell, U. S. N., in the same manner as that used in reducing the published results.

The published observations, corrected as a result of the above-mentioned comparisons, together with the unpublished ones, were compared with the positions of the "Cordoba General Catalogue" and zone corrections were determined for each night's work to reduce the Washington observations to the system of the "Cordoba General Catalogue."

After all the observations had been thus reduced the systematic difference between the "Cordoba General Catalogue" and the "Cape Catalogue" of 1850 was applied as the mean epochs of the Cape, and the Washington observations are approximately the same.

A comparison with a manuscript copy of a catalogue of the mural zones prepared by Dr. E. S. Holden and furnished the observatory through the courtesy of Dr. Holden and Professor W. W. Campbell, while disclosing a number of differences in identification, has led to only nine changes in the 8,744 observations so far compared.

A preliminary discussion of the catalogue positions gives the following mean differences between two observations.

MEAN DIFFERENCE BETWEEN TWO OBSERVATIONS IN RIGHT ASCENSION

Instrument	1846–1849 (Eye and Ear)				1851–1852 (Chronograph)	
	Number of Differences	Two Threads in Each Observation	Number of Differences	Three Threads in Each Observation	Number of Differences	Five Threads in Each Observation
		s		s		s
Mural circle	246	0.20	172	0.16	150	0.09
Transit instrument.	334	0.17	70	0.15	394	0.11
Meridian circle.....	224	0.22	213	0.18	286	0.15

MEAN DIFFERENCE BETWEEN TWO OBSERVATIONS IN DECLINATION

Instrument	1846–1849		1851–1852	
	Number of Differences	Mean Difference	Number of Difference	Mean Differences
Mural circle	407	1.″5	142	2.″1
Transit instrument.	206	2.8	331	2.5
Meridian circle.....	394	2.5	244	1.9

At the present time over one half of the printer's copy of the catalogue is completed. As fast as the copy is finished one set of the results is being sent to Dr. A. Auwers, of Berlin, for insertion in the "Geschichte des Fixsternhimmels." The entire catalogue will be ready for the printer in two or three months.

W. S. EICHELBERGER

January, 1910

THE AMERICAN SOCIETY OF ZOOLOGISTS EASTERN BRANCH

THE Eastern Branch of the American Society of Zoologists met at the Harvard Medical School, Boston, Mass., on December 28, 29 and 30, 1909.

The following resolution was adopted:

Resolved (1) That the Eastern Branch of the American Society of Zoologists express its gratitude for the work of the Commission on Nomenclature of the International Zoological Congress.

(2) That it is the sense of the society that the commission be encouraged to extend its present work of deciding questions as to particular specific and generic names.

(3) That it is the sense of the society that the commission should of its own motion extend its jurisdiction to the ruling in or out of particular works of disputed status, like the Museum Bolteneanum.

(4) That in rendering decisions the commission have power to disregard the priority rule for sufficient and specified equitable reasons.

(5) That all members of this society should submit their questions of nomenclature to the international commission and abide by its decisions.

The president of the society, Professor H. S. Jennings, Johns Hopkins University, and Professor E. L. Mark, Harvard University, were appointed to act as delegates of the society at the eighth International Zoological Congress.

Officers were elected as follows:

President—Thomas H. Montgomery, Jr., University of Pennsylvania.

Vice-president—Harris H. Wilder, Smith College.

Secretary-treasurer—Herbert W. Rand, Harvard University.

Member of Executive Committee—David H. Tennent, Bryn Mawr College.

The following papers were presented:

The Segmentation of the Salpa Stolon, with some Reflections on Segmentation Generally: W. E. RITTER, University of California.

Some Problems of Cœlenterate Ontogeny: CHAS. W. HARGITT, Syracuse University.

The paper briefly reviews certain facts of hydroid development brought to the attention of the society on previous occasions, and cites additional facts and observations which confirm the earlier results. Of the latter may be cited those found

to occur in the development of *Pennaria australis*, a hydroid having much in common with the local species, and corroborating its phases of development in a very remarkable degree. It may be added that these facts taken with those already known as to the perfect development of polyps from even the most erratic early cleavage leave no further room to doubt the perfectly normal character of the phenomena described.

Facts in the development of *Clava*, *Hydractinia* and *Tubularia* were also cited as confirming the previous conclusions, and thus further extending the peculiar behavior under consideration.

Associated with the above were certain inferences and reflections of considerable theoretical significance. Attention was directed especially to facts of histogenesis. It was shown that much of earlier speculation concerning this feature was tinctured with error. Later facts of hydrozoan ontogeny have not afforded any clear support of these earlier speculative contentions. Special emphasis was placed upon the fact that histogenesis in cœlenterate ontogeny is of small homological value and apparently wholly devoid of phylogenetic significance. In fact, the processes involved in the formation of the germ layers are primarily physiological and not morphological. Both ectoderm and entoderm arise thus; the first for protective and locomotor ends, the second for digestive purposes and through specific digestive or nutritive processes in the morula or planula.

The detailed paper will appear later in the *Journal of Morphology*.

Development of the Paraphysis and Hypophysis in the Alligator: A. M. REESE, West Virginia University. (Presented by title.)

The paper will be published in full in the "Smithsonian Miscellaneous Collections."

The Independent Origin and Self-differentiation of the Lens of the Eye: CHARLES R. STOCKARD, Cornell Medical School.

Normally the embryonic optic vesicle comes in contact with the lateral ectoderm of the head and this ectoderm responds to the presence of the vesicle by proliferating a mass of cells which develop into the crystalline lens. The question arises whether the ectoderm may form a lens even though the optic vesicle fails to come in contact with it, and further, what influence does the optic vesicle or cup exert over the subsequent development of the lens? The problem is more complex than it would seem at first sight and involves principles similar to those expressed in the correlation between the development of certain secondary parts and the internal secretions formed by organs on which these parts appear to depend.

By artificially suppressing and retarding the development of the optic vesicles in fish embryos I have obtained exceptional material for the study of the lens problem and from such embryos the following conclusions may be drawn.

A crystalline lens may originate from the ectoderm without any direct stimulus from either the optic vesicle or the brain tissue. The independent lens-bud is capable of perfect self-differentiation and finally becomes a refractive body identically similar in histological structure to a normal lens within the eye. The size and shape of a lens are not entirely controlled by the associated optic cup.

An optic vesicle, whether normal or defective, is invariably capable at some stage of its development of stimulating the formation of a lens from ectoderm with which it comes in contact. This ectoderm may even be out of the usual lens-forming region. Ectoderm of the head region, however, is more disposed to the formation of lenses than that of other parts of the body, as is indicated by the fact that the free lenses invariably occurred in this region.

In *Fundulus* embryos the deeply buried optic vesicles are unable to form lenses from their own tissues, although this is not true in all animals.

Further Data Concerning Twins: H. H. WILDER, Smith College.

The distinction formerly made between the two biological types of twins was reiterated, viz., duplicates and fraternals, the one presumably from the division of a single egg, after fertilization; the other from two separate eggs. Outline tracings of palms and soles of numerous individuals were presented for examination and comparison. These showed (1) that in twins of the duplicate type the main features in the configuration of the palmar and plantar epidermic ridges (friction ridges) are practically identical, and always in the case of all four sets of members; (2) that in twins of the fraternal type these features are as unlike as in any two children of one family but of different birth; and (3) that although single hands or single feet, or perhaps both hands or both feet, of two children of separate birth, especially in a large family, might be found to be as nearly alike as in cases of duplicate twins, this similarity does not extend to all four sets of chiridia, as always in these latter cases. Tracings of four sets of duplicate twins, of four

sets of fraternal twins, and of two sets of similar children of separate birth, were shown in support of the theory as stated.

Manufacture of the Squid Spermatophore: G. A. Drew, University of Maine.

Developmental Changes in Egg Substances: Edwin G. Conklin, Princeton University.

In normal, living eggs of *Physa, Limnæa* and *Planorbis* two ooplasmic substances may be recognized, a milky or clear-gray substance, which comes to the surface of the egg at the animal pole at the time of the first maturation and which then gradually spreads over the upper hemisphere, and a yellow yolk-laden substance which is uniformly distributed through the egg before maturation, but is confined to the vegetative hemisphere after both maturation divisions. During the cleavage the clear-gray substance goes into the three quartets of ectomeres, the yellow material into the entomeres and mesomeres.

When centrifuged with a force equal to 600 times gravity for from five to twenty minutes these substances stratify in three zones, a gray zone of light substance at the central pole, a yellow zone of heavy substance at the distal pole, and a zone of clear substance, containing the nucleus, between these two.

When centrifuged before the first maturation division the proportions of these three substances are, gray one eighth, clear three eighths, yellow one half. Centrifuged just before the first cleavage, the gray and clear substances are not distinctly separated and the proportions are, gray and clear seven eighths, yellow one eighth.

Before the first maturation the centrifuged eggs orient rapidly with the yellow pole down and the gray pole up; after the maturation divisions these same eggs orient very slowly, though the gray and yellow substances remain distinct. Also eggs centrifuged after the maturation divisions orient very slowly.

Before the first maturation the gray and clear substances are finely granular, without the appearance of vacuoles or spherules, and the yellow material is coarsely granular and contains yolk spherules. After the maturation divisions the gray and clear substances contain vacuoles or spherules, and the yellow is apparently less spherular than in the earlier period.

Some of these changes may be due to the increased viscosity of the ooplasm in the later stage as compared with the earlier one, though this is not the only factor involved, since the stratification is less complete in later stages even when greater centrifugal force is used. In probably all cases there is a redistribution, to a certain extent, of the stratified substances during mitosis, but this is never complete, and the original planes of stratification may be observed for a long time during the development.

All eggs centrifuged before the first maturation division develop normally; centrifuged during the maturation divisions about one half develop normally, and one half abnormally; centrifuged at the time of the first cleavage, or just before, almost all develop abnormally. There is no evidence that this result is due to greater injury to the mitotic figure in the later stages than in the earlier ones. Embryos, otherwise entirely normal, may be produced in which the yellow and gray substances may be distributed in any axis, and even where the distribution of all the substances to the cleavage cells is abnormal and unsymmetrical, normal development may result.

Neither the yellow nor the gray substances are formative, and neither are indispensable to development. They may be distributed to the first four cells in varying proportions and yet the resulting development may be perfectly normal; either may even be thrown entirely out of the egg and yet the remainder may develop into a normal snail. The gray substance is largely of a fatty nature, the yellow contains yolk, and both may be regarded as "inclusions" in the protoplasm. On the other hand, the clear substance is indispensable to development, though it may be formed anew in cells which lack it if a nucleus is present, and this clear substance in turn contributes to the growth of the nucleus, whereas the other substances do not. Finally, the clear substance alone, of all the ooplasmic substances, increases in quantity during development. It is therefore true protoplasm. Nevertheless, normal development may result from eggs in which this substance is abnormally distributed as regards both polarity and symmetry, and in this respect it does not correspond to the "ground substance" of Lillie.

The Fertilization Membrane of Nereis: Frank R. Lillie, University of Chicago.

In the unfertilized egg of the *Heteronereis* found swarming at the surface of the water on moonless summer evenings at Woods Hole, there occurs a layer of coarsely alveolar protoplasm between the vitelline membrane and the yolk-bearing protoplasm. This layer, which is 6–7 μ in thickness and entirely devoid of yolk, has been called the

zona radiata by Wilson. The perivitelline space arises by the extrusion of the homogeneous contents of the alveoli of this layer through the vitelline membrane into the sea water, where it forms by swelling a layer of jelly, which may be as much as 100 μ in diameter. The walls of the alveoli remain and form a protoplasmic lining of the vitelline membrane and exceedingly delicate strands of protoplasm crossing the perivitelline space. The perivitelline space is, therefore, *intraovular*.

The fact that the egg of *Nereis* thus secretes its own jelly may readily be demonstrated by fertilizing under the microscope with excess of sperm. If excess of sperm be added to closely placed eggs and a cover glass applied so as to force the eggs into a single layer, and the preparation examined with no loss of time, the spermatozoa will be seen in large numbers in immediate contact with the vitelline membrane. In one or two minutes the spermatozoa are moved away from the surface of the eggs by some invisible repelling substance, and they unite in lines that form hexagonal areas, with an egg in the center of each. The substance that sweeps the spermatozoa away from the eggs is the jelly, and synchronously with its formation the cortical layer disappears, leaving the perivitelline space crossed by protoplasmic strands as already noted.

In the case of each egg a single spermatozoon remains attached to the vitelline membrane. But this spermatozoon requires about twenty-five minutes to penetrate completely through the membrane. The stimulus to development thus precedes penetration by a considerable interval of time.

Unfertilized eggs retain the cortical layer and form no jelly, but if they are centrifuged or sufficiently stimulated with KCl the jelly forms, the perivitelline space arises and maturation takes place. KCl eggs may then differentiate further, but without cleavage.

It would appear, then, that any condition that so alters the permeability of the vitelline membrane as to permit the outflow of the alveolar contents of the cortical layer initiates development, but that the normal continuation of development is dependent on other factors.

Factors which Influence the Maturation of the Egg and Ovulation in the Domestic Cat: W. H. LONGLEY, Yale University. (Introduced by W. R. Coe.)

The course of maturation and ovulation in cats which have paired has been briefly sketched by R. Van der Stricht[1] in a preliminary paper. He finds correctly that two polar bodies are formed, the first in the ovary, and the second in the Fallopian tube, but does not note, as the case is, that the formation of the second is conditioned by the entrance of the sperm head into the egg.

The conclusions herein arrived at depend largely upon data derived from animals not allowed to pair.

Tube eggs before fertilization or in early phases of that process, that is, just after leaving the ovary, are approximate spheres. Each has a thick, tolerably uniform zona with no leucocytes or granulosa cells within it. The corona of each is highly radiate.

The study of the recently ruptured follicle shows that its epithelial lining is always very thin and the follicle just before rupture shows a high cumulus containing lacunæ.

These criteria exclude from the class of normal eggs all such as are found undergoing maturation in the ovaries of animals sexually immature, or in mature animals at the beginning of heat, or at any time during heat, if pairing does not occur. In so far, therefore, as it anticipates normal development, the maturation of the cat's egg is dependent upon pairing.

Of ten animals killed at periods ranging from 23 to 50 hours after pairing, six had already ovulated, and the one killed at 23 hours would surely have done so within the longer time mentioned. In a second series of five animals not allowed to pair, individuals were killed at 56, 73, 74 and 144 hours after first being noted to be willing to pair. None of these had ovulated, as opposed to the 70 per cent. of the first series. Still another was killed one week after the close of a period of heat of at least six days. This animal likewise had not ovulated.

The ovaries of the animal last mentioned showed three distinct series of degenerating eggs, which would easily bear the interpretation that they represented groups which had successively come to the point where they awaited the stimulus of pairing to bring about their discharge, but failing to receive it, had degenerated.

Thus in spite of the fact that Bonnet[2] has recorded a tube egg in an animal which he be-

[1] "Vitellogènese dans l'ovule de la chatte," *Ann. de la Soc. d. Med. d. Gand.*, 1908.

[2] "Beiträge zur Embryologie des Hundes," *Anat. Hefte*, Bd. IX., 1897.

lieved had been confined beyond the possibility of impregnation, from the evidence presented it would appear that ovulation in this animal, as well as in the rabbit (Heape[3]) and ferret (Marshall[4]), is strictly dependent upon pairing.

Early Maturation Phenomena in the Primary Oocyte of Sabellaria vulgaris (Verrill): H. E. Jordan, University of Virginia. (Presented by title.)

Only ovarian and free cœlomic eggs have been studied. The material was collected at Cold Spring Harbor, L. I. The youngest oocyte, almost wholly nucleus, has a diameter of 4 microns. The diameter of the full-grown egg varies from 50 to 60 microns. Maturation proceeds to the metaphase of the first polar spindle in the ovary, after which a pause ensues until fertilization. The youngest oocytes are in synizesis. The intensely chromatic spireme is distinctly polarized. The spireme segments into a large number of V-shaped chromosomes. The shape and manner of formation of the latter suggests telosynapsis.

The chromosomes persist in various shapes through the entire growth period. The chromosomes, as arranged on the spindle, are very small and slender. As many as forty have been counted in three consecutive sections, but this may represent a second count of several. Occasionally, the chromosomes are massed close to the nucleolus before their entrance into the spindle. The spatial relationship between the chromosomes and the nucleolus appears less intimate than in several forms studied, *e. g.*, *Asterias* and *Cumingia*.

Both nucleolus and centrosomes disappear at metaphase. The cytoreticulum is coarse and its meshes are filled with spheric yolk granules. The astral rays are clearly continuous with the cytoreticulum. The evidence here favors a spongioplastic origin of the amphiaster.

The Relation of Nucleoli to Chromosomes in the Egg of Cribrella sanguineolenta (Lütken): H. E. Jordan, University of Virginia. (Presented by title.)

The material for this study was collected at South Harpswell, Me. The full-grown ovarian egg is very large. It has an alveolar cytoplasm, and its large eccentric nucleus (diameter 300 microns) contains very numerous chromatic nucleoli of graded sizes. Occasionally it may also contain an additional very large nucleolus, the remains of the originally single nucleolus. Scattered among the nucleoli, and frequently in intimate contact with them, are a number of beaded chromatic threads of varying length, the chromosomes. The nuclear appearance suggests an amphibian egg.

The single nucleolus of the earliest stage gives origin to secondary nucleoli, apparently by a process of extrusion. These in turn produce still smaller nucleoli by a similar process. The final products of nucleolar budding are approximately equal in size to the granules of the chromosomes. The evidence indicates that the chromosomes are formed of the final products of nucleolar dispersion. The chromosomes arise from the original nucleolus or its products, at least to the extent that their chromatin content is supplied by them.

An interesting generic difference in the manner of the formation of the nucleoli obtains between *Echinaster* and *Cribrella*. In the former the single nucleolus fragments into secondary formations; in the latter the nucleolus extrudes secondary nucleoli. In the former again, the products are usually four-lobed; in the latter spheric. In an earlier study of *Echinaster* I was inclined to interpret these quadripartite bodies as chromosomes or possibly their constituent elements. In the light of facts derived from a study of *Cribrella*, it seems more probable that the several beaded chromatic threads found in *Echinaster* are also there the chromosomes. This, however, does not invalidate the conclusion that in the last analysis the chromosomes arise from the nucleolus. The four-lobed bodies more probably represent a peculiar stage in the process of nucleolar budding preparatory to chromosome formation as in *Cribrella*.

Dimegaly of the Sperm Cells of Euschistus: T. H. Montgomery, Jr., University of Pennsylvania.

Experiments on the Effect of Conjugation on the Life History in Paramecium: H. S. Jennings, Johns Hopkins University.

Pairs that were beginning conjugation were isolated, in some cases separating the individuals before conjugation was consummated, in others allowing conjugation to occur. Both sets were then kept under identical conditions, and their reproductive powers and vitality observed. Comparison of about two hundred of those that had been allowed to conjugate and of those that had

[3] "Ovulation and Degeneration of Ova in Rabbits," *Proc. Roy. Soc. Lond.*, Vol. 76B, 1905.

[4] "The Œstrous Cycle in the Common Ferret," *Quart. Jour. Mic. Sci.*, Vol. 48, 1904–05.

not showed: (*a*) Those that had conjugated divided less rapidly for about a month, when the difference became equalized. In no case did those that had conjugated show a more rapid rate of fission, even after more than a month. (*b*) Many of those that had conjugated did not divide at all, or divided but once or twice in an abnormal way, then died. All those that had not been permitted to conjugate lived and divided normally. (*c*) Among those that had conjugated many abnormalities and monstrosities occurred, while none occurred among those not permitted to conjugate. Thus the experiments gave no indication of a rejuvenating effect of conjugation. It was suggested that conjugation might be preliminary to a resting condition, in which unfavorable environmental conditions are tided over.

Effect of External Agents upon Growth in Paramecium: A. H. ESTABROOK, Johns Hopkins University. (Introduced by H. S. Jennings.)

Examination was made of the growth of *Paramecium* in pure distilled water, and in solutions of sodium chloride, nicotine, strychnine nitrate and alcohol, the results being compared with the growth in hay infusion.

It was found that the cell after fission has a strong tendency to grow in a perfectly definite way, at a definite rate, the growth giving a definite curve. It thus grows in spite of the absence of any food materials; in spite of the almost complete absence of the usual salts in the water, and in spite of the presence of actively injurious chemicals that later kill the organism. Evidently inner conditions give the animal a potential of growth which it is difficult to overcome.

No evidence was found that by subjection to chemicals a race of a given type can be transformed into a larger or smaller race.

Does Lecithin Influence Growth? A. J. GOLDFARB. (Introduced by T. H. Morgan, Columbia University.)

After referring to the chemical nature of lecithin, the speaker pointed out the rôle of lecithin in the living cell. The evidence was then reviewed upon which the generally accepted view is based that lecithin exerts a marked acceleration upon the growth of an animal.

The speaker then described his own experiments upon the same kind of animals as those used by previous investigators. Emphasis was laid upon the following: (1) the greatest pains had been taken to free the lecithin from impurities; (2) variations due to environmental factors were reduced to a minimum; (3) the large number of animals used rendered it practically certain that the resulting data did not represent individual variations; (4) the degree of variation for each kind of animal was ascertained by comparing the controls for each series and litter; (5) animals given lecithin in doses ranging from subminimal to injurious showed no definite corresponding increased growth. The utmost irregularity prevailed. Approximately one half the animals grew faster, one half slower than the respective controls. The gain was well within the normal variation.

Regardless of the kind or dose of lecithin used, or the manner of administering it, lecithin did not accelerate the growth of animals.

Is the Stimulation toward Artificial Parthenogenesis a Physical or a Chemical Process? J. F. MCCLENDON, Cornell Medical School.

I caused artificial parthenogenesis in the eggs of *Arabacia punctulata* by the following agents which stimulate muscle and produce hæmolysis: isotonic NaCl, and the following chemicals and conditions in sea water: acids, alkalis, hypertonicity, hypotonicity, ether, diminished oxygen, KCN, heat, cold, induction shocks and mechanical agitation. All of these methods probably increased the permeability of the eggs, causing a disappearance of the positive charge on the surface and thus increasing the surface tension. A band of greatest surface tension around the egg would cause cleavage, contrary to Robertson, whose experiment was vitiated by the fact that the oil drop used as a model was floating on water. I found that just before cleavage the pigment plastids migrated to the egg surface, which, if they were charged negatively, would result from the potential gradient produced at the moment the egg surface became more permeable. The fact that CO_2 and catalase come out of the egg and oxygen enters the egg, in increased amount about the time of cleavage, indicates increased permeability. The substances increasing, the permeability may enter the egg later, although their specific action was on the surface. The fact that rise in temperature causes parthenogenesis invalidates Loeb's deductions from the temperature coefficient, and the factor common to fertilization and artificial parthenogenesis is probably physical, *i. e.*, increased permeability.

The Biological Cycle of the Hay Infusion: LORANDE LOSS WOODRUFF and MORRIS S. FINE, Yale University.

The data derived from the continuous study, by means of daily counts, of the organisms of a series of hay infusions made by three standard methods were summarized. The following general observations were made:

1. The distribution of the organisms, broadly speaking, is successively at the middle, top, middle and bottom of the infusion. The distribution is determined primarily by the supply of food and oxygen.

2. The so-called cycle of organisms and their distribution is not due to inherent changes in the potentiality of division of the organisms, but to progressive changes in the environment, *i. e.*, the "cycle" is in the medium and not in protoplasmic changes of the organism.

3. Many species of infusoria do not resort to conjugation to sustain rapid cell division when the environment is slowly changing, but encyst and remain at the bottom when the conditions become somewhat unfavorable. Epidemics of conjugation usually occur when the environment is rapidly changing. Data suggest that conjugation may be a means of surviving acute changes in the environment which, for example, preclude encystment.

The fauna and flora of the infusions were studied by L. L. Woodruff and the chemical changes by M. S. Fine.

The Converse Relation between Ciliary and Neuro-muscular Movements: Alfred G. Mayer, Carnegie Institution of Washington.

Among the cations of sea water, sodium is the most potent inhibitor of ciliary activity, and the most powerful neuro-muscular stimulant.

On the other hand, magnesium is the most potent in maintaining ciliary movement, and the most powerful inhibitor for neuro-muscular movements.

Potassium in weak concentrations, such as is found in sea water, is a primary depressant for cilia, but afterwards ciliary action recovers in its presence. For neuro-muscular movements, however, it is at first a stimulant and finally a depressant.

Calcium is a weak stimulant for ciliary movement, but a depressant for neuro-muscular activity.

Ammonium at first stops and finally permits of recovery of ciliary movement, but it at first stimulates and afterwards inhibits neuro-muscular movements.

Weak concentrations of acids (H ion) at first depress and afterwards permit recovery of ciliary movement, but they at first stimulate and afterwards depress neuro-muscular movements.

In each case the effect of the salt is exerted through its cation.

We may present these results in a graphic manner if we represent a stimulus by a + sign, and an inhibition of movement by a — sign, the greater the effect the larger the print. Successive effects may be represented by a succession of signs; thus: —+ means a depression followed by recovery of movement and +— an initial stimulus followed by depression. Bearing this preamble in mind, the following table will illustrate the effects of the various cations:

Cations	Effect upon Neuro-muscular Movement	Effect upon Movement of Cilia of Animals
Sodium	+	—
Magnesium	—	+
Potassium	+—	—+
Calcium	—	+
Ammonium	+—	—+
Hydrogen	+—	—+
Lithium	+	—

Ringer's solutions, which consist of sodium, potassium and calcium chlorides, are powerful initial stimulants but finally produce depression of movement and muscular tetanus. This deleterious effect can, however, be overcome by adding magnesium, although this destroys the stimulating influence of the solution.

My experiments suggest that in surgical operations involving considerable loss of blood the Ringer's solution, which it is the practise to inject into the blood system to stimulate the heart, should be followed after recovery from the shock of the operation by a solution containing the amounts and proportions of sodium, potassium, calcium and *magnesium* found in the blood, thus counteracting the injurious after-effects of the Ringer's solution.

The Summation of Stimuli in Invertebrates: Frederic S. Lee, Columbia University, and Max Morse, College of the City of New York. (Introduced by R. C. Osburn.) The paper will be published in the *American Journal of Physiology*.

Summation of stimuli has been described in both plants and animals and is a wide-spread physiological phenomenon. It is usually ascribed

to an increase in irritability, such that a stimulus that is too weak to cause a response when applied singly, will, upon repetition, prove effective. The observations here reported were made on the muscles of certain species of invertebrates, namely, *Cyanea arctica, Aurelia flavidula, Homarus americanus, Carcinus mœnas, Cancer irroratus* and *Cancer borealis*. The major part of the work was done on *Cyanea arctica, Carcinus mœnas* and *Homarus americanus*, the muscles of all of which possess a marked power of summating stimuli. It was found that the irritability of the muscles can be raised by the administration to them of carbon dioxide or lactic acid in great dilution. Solutions of lactic acid of from 1/100 gram molecular to 1/6400 gm. were used, the best results being obtained by the use of 1/1600 gm. It was found possible by these reagents to change the threshold of stimulation so that a muscle responded by contractions to shocks from an inductorium which previously were unable to elicit responses. Thus by the injection in small quantities of agents which in larger quantities depress the action of muscle, it is possible to enable the muscle to respond to stimuli previously ineffective. Gotschlich found that subminimal stimulation of muscle renders it acid in reaction, even though no contractions occur. The conclusion, therefore, seems to be justified that summation of stimuli is due to a rise in irritability, brought about by the action on the living substance of small quantities of certain products of metabolism, especially carbon dioxide and lactic acid, the same substances which in larger quantities are important factors in fatigue.

Rates of Regeneration in Various Salt Solutions, and the Influence of Regenerating Tissue on the Animal Body: CHARLES R. STOCKARD, Cornell Medical School.

The processes of regenerative growth in the salamander are favorably affected by weak doses of KCl while $CaCl_2$ inhibits the rate of growth and differentiation of the part. Solutions of $MgCl_2$ also inhibit growth and differentiation, yet not so decidedly as the $CaCl_2$. Mixtures of half doses of $CaCl_2$ and $MgCl_2$ do not influence either growth rate or differentiation.

The influence of a salt solution is largely dependent upon the salt to which the animal has been previously subjected, even though some time may have elapsed since the former treatment was applied. Animals that have regenerated at a fair rate in solutions of KCl are less depressed by treatment with $CaCl_2$ than others which have not been treated with KCl.

When animals are unfed they decrease in body size. This decrease is greater in regenerating individuals, and the larger the amount of tissue an individual is regenerating the more rapidly does it decrease in size. The new regenerating tissue grows at a vigorous rate on account of its excessive capacity for the appropriation of nutriment from the old body tissues, and it is this fact that causes the body to decrease in size and become weak and emaciated. A closely similar action is seen in the behavior of certain malignant growths.

On the Structure and Regeneration of the Epidermal Layer in some Siliceous Sponges: H. V. WILSON, University of North Carolina. (Presented by title.)

The epidermal layer in two monactinellid sponges (*Stylotella* and *Reniera*) was studied. Various histological methods were employed. The epidermis does not consist of flat epithelium cells (pinacocytes), but is a continuous, thin sheet of protoplasm studded with nuclei and entirely without cell boundaries. It is a syncytium.

The pores are the superficial apertures of very short canals (pore-canals) which perforate the dermal membrane. Closure of the pore is brought about by an extension (pore-membrane) of the thin epidermal layer over the pore-canal. The pore-membrane in *Stylotella* from the start is continuous and diaphragm-like. In *Reniera* the pore-membrane in the early stages of pore-closure exhibits active, amœboid changes of shape and position.

In *Stylotella* a new epidermis develops over a cut surface in the course of a day. It is formed by the cells of the mesenchyme, which are already interconnected by slender processes. The mesenchyme cells crowd to the surface and flatten out. At this time they are close together and connected by a reticulum of delicate, protoplasmic strands. Union between the cells then becomes perfect, their boundaries disappearing.

Wound Reparation and Polarity in Tentacles of Sagartia: HERBERT W. RAND, Harvard University.

If a distal piece is cut from a tentacle of *Condylactis* or other large actinians, the wall at the cut edge of the stump immediately bends inward slightly. Then a broad zone of wall at the cut edge contracts until its lumen is obliterated, so that the distended stump, now functionally

closed, bears a conspicuous projecting cylindrical "nipple." Within two days the contracted zone gradually relaxes, the nipple disappears, and the end becomes structurally closed.

The relatively very small tentacles of *Sagartia luciæ* show similar behavior, but the structural closing is accomplished within six hours.

Sagartia was kept in a solution of chloretone such that all muscular activity was suspended during eight hours. The initial inbending at a distal cut edge nevertheless took place. But the zone of wall which ordinarily contracts to form the nipple did not contract; no nipple was formed. *A steady centripetal movement of uncontracted tissue at the cut edge occurred until within eight hours the cut end was structurally closed.*

The temporary nipple, therefore, results from muscular contraction, but the definitive closing depends upon non-muscular activities which effect a spatial readjustment of the tissues near the cut edge.

The regions of a tentacle which are proximal and distal with reference to a plane of cutting or the point of application of a tactile stimulus differ markedly in their immediate reactions to the cutting or the tactile stimulus. The form assumed by a proximal cut end is distinctly different from that of a distal cut end. In these respects the *Sagartia* tentacle tissues, like those of *Condylactis*, show a distinct polarity which is not explicable upon the basis of their known structure.

The Regulation of the Water Content in Regeneration: Sergius Morgulis, Harvard University. (Introduced by E. L. Mark.)

An examination of the water content at successive stages of regeneration in a polychæt, *Podarke obscura*, showed that the percentage of water rises rapidly soon after the operation, reaching a maximum between the first and second weeks, approximately at the time of highest regenerative activity; subsequently it begins to decline. In this respect (rise and fall of the percentage curve of water) regeneration is essentially like embryonic growth. But while in embryonic growth the increase of the percentage of water is due to imbibition of water from the surrounding medium, this, apparently, is not the case in regeneration.

The regenerating worms, whether fed or starved, are losing in weight, and three phases of regulation of the water content in the organism may be distinguished during the process. At first there is rapid loss in weight, but proportionally more dry substance than water is lost, the percentage of water rising. Then follows a period of rather slow diminution in weight, when practically no water is being lost, the content of water attaining its maximum. Lastly, comes a period during which proportionally more water than dry substance is being lost, the percentage of water thus declining.

The Behavior and Structure of a New Species of Gregarine: R. A. Budington, Oberlin College.

The form described occurs in the alimentary tract of the barnacle, *Balanus eburneus*. It is of the polycystid plan of structure, and is conspicuous for the rapidity and complexity of its movements. Prolonged progression in a straight line, flexures and torsion of the body, movements of the protomerite in all planes independently of the rest of the body, are specially noticeable. Disturbances in the environment of the animal during its progression do not seem to be accounted for on the basis of either Schewiakoff's secretion theory or Crawley's epicytic undulations.

The nucleus, both while living and when stained "intra-vitam" and after fixation, shows an average of about five very distinct karyosomes ("prochromosomes"). Bodies of precisely similar appearance and which react similarly to nuclear stains are present in the protomerite; and since the wall of separation between proto- and deutomerite is complete, the chromatin content of the former, though not contained within an organized nuclear wall, make it in certain ways essentially a separate cell.

The Function of the Ear in Cyclostomes: G. H. Parker, Harvard University. (Presented by title.)

Within recent years evidence has been brought forward to show that killifish, goldfish, squeteague and dogfish can hear. No tests have been made on cyclostomes. As their ears are the most primitive in all the vertebrates, they were tested for hearing. Ammocœtes will rest quietly on the padded bottom of a wooden aquarium. When the side of the aquarium is struck by a heavy, swinging pendulum, the fish usually responds by a winking movement of the oral hood and by curving the body. After the eighth nerves are cut, these responses are called forth only by a blow three or four times as strong as that necessary to stimulate the normal animal. When only one nerve is cut, the fish responds in a normal manner. These observations show that the cyclostomes are responsive to sound, not only through the skin, but also through the ear.

The Morphology of the Swim-bladder in Teleosts: HENRY C. TRACY, Brown University. (Introduced by A. D. Mead.) (Presented by title.)

The most important types of swim-bladders are, first, primitive swim-bladders with an open pneumatic duct and undifferentiated epithelial lining, and, second, the highly specialized type without duct but with the so-called "oval" on its dorsal wall.

Two exceptional types are probably to be considered transitional forms. One is the swim-bladder of the eel; the duct is enlarged into a capacious chamber, but its œsophageal connection is much reduced. The duct is lined with flat epithelium under which is a *rete mirabile*.

The other transitional type is found in toadfish (*Opsanus*) and a few other forms. It has lost its œsophageal connection, but is divided into an anterior and a posterior chamber by a transverse partition, through which is a round opening. The structure of the walls of the posterior chamber is like that of the duct of the eel. This chamber develops directly from the embryonic pneumatic duct.

From the posterior chamber of the swim-bladder of the toadfish the transition to the oval may be considered to have taken place by an approximation of the partition to the posterior wall of the organ. The red gland develops by a progressive differentiation of the epithelial lining.

Ciliation of the Palps of the Acephala: J. L. KELLOGG, Williams College.

The known function of the ciliated inner surfaces of the palps of bivalves is to transport food particles from gills to mouth; but they have been found also to possess the power of directing undesirable materials, such as mud, on to ciliated tracts that carry them out of the body.

The inner palp surfaces are found to possess four distinct currents: one across the folds to the mouth; a second in the opposite direction, on the ventral palp margin; a third set of tracts on the faces of the palp folds, from their ventral to their dorsal ends; and a fourth set, deep in the grooves between folds, from dorsal to ventral ends.

The function peculiar to each of these was fully determined during the past summer in several of the large forms of Puget Sound. That of the fourth set is especially interesting. These tracts are entirely covered when the animal is feeding. They are exposed by a peculiar movement of the folds when a large quantity of material is brought to the palps, as is the case in muddy water, the entire mass being led to tracts that convey it from the body. The fate of particles brought to the palps is determined not by their nature—whether suitable for food or not—but solely by their volume.

Parallel Development in Tropical Trematodes: H. S. PRATT, Haverford College.

The digenetic trematodes as well as other internal parasites have probably in their phyletic history followed somewhat different rules of descent from those of other animals. The fact that they live inside of other animals and have also a very complex life history must affect their phyletic development most profoundly, and in two ways: (1) The possibilities of migration are very much limited. (2) The environment of the parasites being extremely uniform and subject to relatively little variation there is a corresponding uniformity of structure in the parasites themselves. Thus we see that although there are several thousand species of digenetic trematodes in existence living in all parts of the world they are astonishingly alike in structure—so much so that until quite recently all of the thousand or more species of distomes were included in the single genus *Distomum*. The monogenetic trematodes, on the other hand, which are external parasites and have consequently a very much simpler life history and a much more varied environment show a much greater variety of structure, although they count fewer species.

These facts make it probable that where there are apparently related species of digenetic trematodes living in widely separated localities the fact that they possess the same or similar structural features does not necessarily indicate that there is a close genetic relationship between them. They have not necessarily inherited their peculiarities from a common ancestor even when they are so much alike that they are classified in the same genus. But they are undoubtedly in very many cases descended from different ancestors and have reached their present structural condition by traveling along parallel or converging lines of descent.

These facts are well illustrated by the several species of digenetic trematodes belonging or allied to the genus *Helicometra* which were found in certain fishes in the Gulf of Mexico at Tortugas, Florida, and also occur in the Mediterranean Sea. That the species of this peculiar genus are thus taken as an indication, not that they necessarily bear a close genetic relationship to one another,

but that similar or identical environmental conditions exist for them in these places, so that they have come to possess in the course of time a structure so similar that they are included in one and the same genus.

A New Rhabdocœle, Commensal with Modiolus plicatulus: Edwin Linton, Washington and Jefferson College. (Presented by title.)

In searching for rediæ in a lot of mussels at Woods Hole in July last a small worm .2 mm. in length was found by the writer which at first was taken to be a redia with numerous cercariæ already active within it. On subsequent dates others were found. They proved to be turbellarians belonging to the genus *Graffilla*.

The species is viviparous, at least in July and August.

All stages of development, from the germ cells in the ovary-vitellarium to active ciliated young with black eye specks, may be seen in the same adult worm. There is a singular lack of uniformity in the details of development, although the outcome as a rule is the development of a pair of young worms within the same egg-membrane.

The worms are active, but move for only a short distance before changing their direction. They tend to move away from the light.

Their distribution is dependent on local conditions. They were not found in mussels which grow on confined coves or marshy places. The best localities for finding them are those which are exposed only at very low tides and where there is rather free tidal movement.

The Inadequacy of the Law of Priority, with a Suggestion for Relief: J. S. Kingsley, Tufts College.

Characteristics of the Diverse Races of Paramecium: H. S. Jennings and Geo. T. Hargitt, Johns Hopkins University.

Jennings has described the existence of a number of diverse races in *Paramecium*, differing constantly in size. The junior author of the present paper undertook a cytological study of six of these races, in order to determine their relation to the supposed species, *Paramecium caudatum* and *Paramecium aurelia*. It was found that two sets of races could be distinguished, one set having two micronuclei, the other but one. The races with two micronuclei were all smaller than those with one. The larger races together thus correspond with what had before been described as *P. caudatum*, the smaller races with *P. aurelia*. The two differ also in the size, position and staining relations of the micronuclei, in ways that correspond to the descriptions of Hertwig and Maupas. But *in rare cases* specimens of the *caudatum* races have two micronuclei, those of *aurelia* races but one, thus confirming the observation of Calkins on this point. The races have remained constant in size in the laboratory for between two and three years. They differ from each other (even within the *aurelia* or *caudatum* group) not only morphologically, but physiologically, especially in their relation to conjugation. It has not thus far been possible to cause the members of one race to conjugate with those of another.

The Pearl Organs of American Minnows in their Relation to the Factors of Descent: Jacob Reighard, University of Michigan.

Pearl organs are horny, conical epidermal upgrowths which occur in males and are functional only during the short breeding season. Extensive observation of the breeding activities of many species has made known in detail the *whole utility* of these organs to the species. They serve chiefly to roughen the skin and enable the male to retain his hold of the female during the brief spawning act.

In form, size and distribution they afford characters by which even the species of a subgenus are easily separable. In general the spawning attitudes of males of different species are such as to bring their roughened surfaces into contact with the female and a Lamarckian or Darwinian interpretation of the origin and differentiation of the pearl organs is thus suggested. Since the number of spawning attitudes is far fewer than the specific distributions of the organs concerned, the one could not have arisen in correlation with the other. From this fact and others it is concluded that the origin and specific distribution of the pearl organs must have come about without reference to utility and through internal forces. Use differences are here superimposed on structural differences in such way that no specific correlation exists between the two.

The Causes that Determine the Fauna and Flora of the Small Islands of the New England Coast; a Study in Natural Selection: A. E. Verrill, Yale University.

Abnormal Individuals of Didinium nasutum and their Bearing on the Question of Natural Selection: S. O. Mast, Goucher College, Baltimore. (Presented by title.)

In large vessels containing cultures of *Didinium*

one occasionally finds specimens with two or three oral ends and several bands of cilia, but never any which are more abnormal. Each oral apparatus is functional in these creatures. I have seen specimens swallow three paramecia at a time. If they are isolated and kept in shallow dishes with plenty of paramecia they thrive and reproduce rapidly. Ordinarily normal specimens are cut off at each oral end and the original individuals remain as they were, but in some cases there is a tendency to form more complicated abnormalities due to incomplete fission.

Many of these are unable to swim and consequently lie on the bottom. If there are numerous paramecia and the water is shallow, they persist indefinitely, and many abnormal specimens are formed as well as normal ones. Under natural conditions, however, such specimens are at once eliminated, for they sink to the bottom while the paramecia on which they feed remain near the surface. Natural selection is thus seen to operate in preventing the perpetuation of these monsters.

Variation in Urosalpinx: H. E. WALTER, Brown University.

Over 50,000 shells of the oyster drill, *Urosalpinx cinereus*, which were collected at various times between 1898 and 1908 from various localities both on the Atlantic and Pacific coasts, were carefully measured and the variation, as shown by standard deviation, computed. So far as the statistical method is able to reveal, it is extremely doubtful whether or not this mollusk when introduced into a new habitat, as happened when they were accidentally transplanted with oysters to the Pacific coast from the Atlantic, exhibits greater variability than in its new habitat. The change of variability appearing in successive fortnights in shells in the same locality, as well as the change showing itself in the August shells of the same locality for successive years, is pronounced enough to indicate plainly the working of an ontogenetic variability independent of environmental modification, that is, a time factor as distinguished from a place factor. In consequence of this, it is practically impossible to collect homologous lots of these shells upon which the place (or environmental) factor may be accurately determined.

Some Results of a Study of the Inheritance of Barring in Poultry: R. PEARL and F. M. SURFACE, Maine Agricultural Experiment Station.

Certain results obtained by reciprocally crossing Barred Plymouth Rock and Cornish Indian Game fowls were described. It was shown that the barred plumage pattern is inherited in these hybrids in a sex-limited manner. The cross Barred Plymouth Rock ♂ × Cornish Indian Game ♀ gives all barred offspring, in both sexes. The reciprocal cross gives barred males and solid black females. It was shown that the degree or intensity of pigmentation (apart from pattern) is not inherited in these hybrids in the manner to be expected if there were a simple blending of the degrees of this character manifested in the parents. The complete paper will shortly be published elsewhere.

Ophiurans and "Jordan's Law": HUBERT LYMAN CLARK, Harvard University.

The study of a large collection of ophiurans from the North Pacific Ocean has shown that closely related species are often found occupying the same area. In several instances, a given species was taken two or more times, in the same trawling, with its nearest known ally. These facts are counter to that principle of the extreme importance of geographical isolation which has recently been formulated and designated as "Jordan's law." An illustration of a form of physiological isolation was offered, found among West Indian ophiurans, which suggests a possible reason why geographical isolation is relatively unimportant in the class.

On the Geographic Distribution of some Pelagic Organisms: H. B. BIGELOW, Harvard University.

The Distribution of Flies in Providence: G. F. SYKES, Brown University. (Introduced by H. E. Walter.)

During the summer of 1909 a series of investigations was begun in Providence, R. I., for the purpose of ascertaining the actual importance of the "house flies" as a factor in the spread of enteric diseases. The following results were obtained: (1) the fly nuisance is local; (2) the geographic distribution of pestiferous flies is determined by local sanitary conditions; (3) the seasonal distribution is conditioned by meteorological influences (temperature and sunshine); (4) over 99 per cent. of all the flies caught (in three kitchens) were *Musca domestica*, the remaining fractional per cent. were *Lucilia cæsar;* (5) the plotted curve for typhoid cases did not show a close relation to the fly curve, but did show a close parallel to the temperature curve; (6) the high-water mark for deaths from diarrhœa antedated that for the fly season by fully three weeks, and followed from one to two weeks after a noticeable

rise in temperature; (7) the geographical distribution of typhoid cases over the city was largely independent of areas known as "unsanitary" and as "fly centers."

The conclusions drawn from these results point toward a more fundamental factor than the house fly in the spread of enteric diseases. Furthermore, judging from the constant relationship which the temperature curve maintained through the experiment, it is not unnatural to suppose that therein lies the solution of the problem; but whether the influence of temperature is real or only apparent, direct or indirect, remains yet to be determined.

The Leaping of the Pacific Salmon: Henry B. Ward, University of Illinois.

Observations made, chiefly in southeastern Alaska, on the red and humpback salmon indicate that the fish do not choose a particular point of attack in endeavoring to surmount a fall. The height and length of the jump were very variable and on the whole there appeared to be a remarkable lack of accuracy as well as of definiteness in the movement. This apparent aimlessness of the leaping may be the result of a fairly precise response to definite stimuli in the water currents which in the small whirlpools below the falls are subject to constant and unexpected changes. When endeavoring to surmount the falls the fish sail through the air with body rigid and fins spread tense, while at the instant when the momentum of the jump is lost one notes a series of rapid and powerful vibrations of the tail; these are made regardless of the success of the jump or of the position of the fish in air or in water. If the fish reaches solid water at the crest of the fall, they insure the maintenance of the vantage thus gained.

The open water jumping is of a distinct type, since the body leaves the water sidewise instead of in a vertical position, the musculature is somewhat relaxed and the fins are partly folded backwards, while finally there is no movement of the tail at the close of the jump. The purpose of this jump is not clear.

Direction of Locomotion of the Starfish (Asterias forbesii): L. J. Cole, Yale University.

It was shown that in the absence of directive stimuli, although starfishes might move with any ray in advance, in a large number of trials it was most often the one lying next to the left of the madreporic plate which went ahead. This may perhaps then be considered the *physiological anterior* of the animal. Attention was called to the fact that in the bilateral echinoids, the spatangoids, it is similarly the ambulacral area to the left of the madreporite which is anterior.

Reactions of Echinoderms to Light: R. P. Cowles, Johns Hopkins University. (Presented by title.)

A review of the literature dealing with the reaction of starfishes to light shows there is a general belief that these animals depend for their responses to light upon the eye spots situated at the tips of the rays. Some authors even state that certain starfish do not react to light when these organs are removed.

While experimenting with the starfish, *Echinaster crassispina*, the writer found that the eye spots may be removed and that the creature may still react to differences in the intensity of the light. The tips of the rays of several echinasters were amputated and these starfish were then tested in a rectangular glass dish lined with dead black paper and filled with sea water. The dish was placed in a black-lined box with a single opening at one end through which bright daylight was allowed to enter. When a series of tests were made the starfish was placed in the dish, care being taken to vary the manner of handling and also to vary the position of the rays with reference to the source of light. In the majority of tests the echinasters moved to the lighter end of the dish, although the reaction was somewhat slower than with normal individuals.

Reactions of Amœba to Light: S. O. Mast, Goucher College, Baltimore.

If direct sunlight is flashed on an active specimen of *Amœba proteus* all movement stops immediately. The pseudopods remain just as they are, without contracting, until after the lapse of a few moments, when new ones are thrown out, usually at the posterior end. Then the old ones gradually disappear. This occurs in the blue of the solar spectrum nearly as definitely as in white light. Green is much less effective; violet, yellow and red have scarcely any effect.

When an amœba comes in contact with a well-defined area of light composed of rays perpendicular to the slide, it usually stops and proceeds in a different direction.

In a horizontal beam of direct sunlight they orient fairly accurately. Changing the direction of the rays produces a change of intensity on the surface, but this causes no apparent retardation in any pseudopods. Nor does difference in light

intensity on opposite sides of a pseudopod induce difference in rate of streaming so as to cause it to bend. Orientation is due to the inhibition of the formation of new pseudopods on the more highly illuminated side of the body of the amœbæ, not to any effect on those already formed.

Colored Lights of Equal Intensity for Biological Work: G. H. PARKER and E. C. DAY, Harvard University. (Presented by title.)

Colored light was produced by passing the light from a Nernst lamp through a solution of an appropriate aniline dye contained in a plate-glass cell and used as a screen. In this way blue, green, yellow and red lights of fair spectroscopic quality were obtained. The intensity of these lights was measured in terms of energy (heat) by means of a radiomicrometer which was accurate to within 2 per cent. The stronger lights were then reduced by being placed at such distances from the animals experimented upon that all lights were of equal intensity at the spot where the animals were. It was proposed to extend this method to spectral light.

Notes on the Behavior and Reactions of Amphioxus: L. HUSSAKOF. (Introduced by Bashford Dean, American Museum of Natural History.)

These experiments were carried on at the Naples station during last September. They dealt with the behavior of amphioxus and its reactions to light, heat, chemical and mechanical stimuli. In some reactions the Neapolitan species, *Branchiostoma lanceolatum*, behaves differently from the Bermuda form, *B. caribbæum*, notably in regard to heat. The former is adapted to a temperature ranging from 35° C. to —.5° C., while the latter (as shown by Parker) will survive only within the limits of 42° C. and 4° C.

The Movements of the Earthworm—A Study of a Neglected Factor: SERGIUS MORGULIS. (Introduced by G. H. Parker, Harvard University.)

While studying reflex reactions of the earthworm I have been impressed with the fact that the worm tends to move in a straight direction, and, once having assumed such a course, it maintains itself obstinately in the path. This simple observation was substantiated by special experiments where, with the aid of an apparatus constructed for this purpose, the anterior or posterior part of the worm was deflected either to the right or to the left from the straight course. By turning the tail to the right, for instance, the head would be caused to turn to the left, and *vice versa*. The position of the tail could be changed several times successively, first to the right, then to the left, etc., and the head would likewise change its position but in an opposite direction. The extent of the orientation reaction of the head was found to be directly proportional to the length of the posterior part of the worm deflected from the straight course; while the degree of deflection of the posterior part necessary to occasion a bending of the head in an opposite direction is inversely proportional to the length of this part. Depending upon the relative position of its tail, the earthworm responding to unilateral stimulation turns either towards or away from the stimulus until it has assumed a straight position, and then it begins creeping in that direction.

The Leucocyte Content of Milk: R. S. BREED, Allegheny College.

Studies upon the Nerve Cells of Invertebrates: W. M. SMALLWOOD and C. G. ROGERS, Syracuse University.

The nerve cells of all invertebrates so far examined, including representatives of more than twenty genera of molluscs, worms and crustacea, contain pigmented or unpigmented solid granules of various sizes.

The same nerve cells show also the presence of many vacuoles, containing a transparent liquid. These may be very abundant and are located principally in the outer zone of the cytoplasm.

The vacuoles represent granular deposits which are in process of transformation, so as to furnish energy for the work of the cells.

Excessive work upon the part of the cells, starvation, etc., serve to bring about the destruction of the granules, and their replacement by vacuoles. The granules may, therefore, be considered to be storage material which may be called upon at any time of special stress to furnish energy for the work of the cells.

Some Observations on the Behavior of the Beach Flea, Orchestia agilis: A. M. BANTA. (Introduced by C. B. Davenport, Carnegie Institution, Station for Experimental Evolution.)

When disturbed by lifting the eel grass the animals are largely negative to light. In a few minutes if prevented from concealing themselves they become positive and remain so if the intensity of light remains constant or is increased. If the intensity is materially decreased, however, the orchestias become *negative*. This is a most exceptional reaction. With most organisms, if there is a reversal of the light reaction with change in intensity, the negative reaction is to

the higher intensity and the positive to the lower intensity. When thus made negative to dim light *Orchestia* becomes again positive if exposed to strong light. Kept in dry air, the animals become negative. After retention in darkness they are positive. Placed in water they are negative.

A number of these reactions are of evident importance in the animal's daily movements. The reversal from positive to negative with decrease in illumination aids in directing the animal's movements in reentering the eel grass, as likewise does the negative reaction when becoming too dry. The animal's negativity when in water aids it in reaching shore when overtaken by the tide, the shore line serving as a dark region as compared with the equally illuminated expanse of water in all other directions.

On the Transition from Parthenogenesis to Gamogenesis in Aphids and Braconids: S. J. Hunter, University of Kansas.

Continuous experimental study since May, 1907, on the aphid, *Toxoptera graminum*, has brought out the following regarding the development of aphids as illustrated by this species:

Parthenogenetic forms appear during the spring, summer and early fall. These forms may be winged or wingless, the latter greatly predominating. The characters of each remain constant until about October 1, when, as first observed by Glenn in this laboratory, these parthenogenetic forms begin to produce intermediate forms varying in structure between the winged parthenogenetic form and true female on the one side and the wingless parthenogenetic form and true female on the other side. Within the bodies of these intermediate forms appear, in some live young, in others winter eggs, in still others both winter eggs and living young. All such intermediate forms, however, die without producing offspring or eggs, as do many of the apterous parthenogenetic individuals belonging to the sexual generation.

These intermediate forms seem to be parthenogenetic individuals affected by the stimuli which bring about the transition from parthenogenetic females to the true sexes. In some the reproductive organs are unmodified, in others they approach the true female type to a greater or less degree. These intermediate forms belong to the sexual generation and may be considered as an attempt toward the development of the sex individual. They play no part in the life of the insect.

The parent of these intermediate forms and of the true female may be either winged or wingless. The males have no intermediate forms and are uniformly the offspring of the wingless parthenogenetic females. One single parthenogenetic wingless individual has been observed to produce types of all the above described forms. The above intermediate forms together with the appearance of the true sexes occur only during October, November and December regardless of the conditions under which the various experimental stocks are kept throughout the year and without reference to the number of generations.

Young growing wheat has been the uniform food plant throughout the entire period of experimentation.

In the braconid, *Lysiphlebus tritici*, a parasite of *T. graminum*, gamogenesis occurs in nature. In one count of a thousand insects taken in the field 5 per cent. were males, in another 35 per cent. By isolation of virgin females in fourteen experiments all offspring were males, and in seven experiments 1 out of 26, 4 out of 27, 3 out of 17, 1 out of 22, 1 out of 18, 1 out of 12, 2 out of 27 were females, making a total for the twenty-one experiments of 339 males and 13 females. In an extensive series of subsequent experiments no females have appeared. Of these parthenogenetic forms it is worthy of note that 203 of the males had 15-jointed antennæ, 131 had 14-jointed antennæ and 5 had 16-jointed antennæ. Of the 13 females, 8 had 13-jointed antennæ and 5 had 12-jointed antennæ. Gamic females show the same conditions, but among gamic males no 16-jointed forms have been found. Polyembryony does not occur in this parasite.

Proliferation of Eyes in an Abnormal Tentacle of a New Species of Marine Gasteropod: F. N. Balch. (Introduced by G. H. Parker.)

In the unique specimen of *Onchidiopsis corys* sp. nov. the left tentacle is bifid, the internal, or mediad, member appearing nearly normal and bearing a normal eye. The external member is abnormal in size and shape, is folded backward, bears on the surface thus exposed (but morphologically mediad) a normal-appearing eye, and if folded forward into its true morphological position would be the mirror-image of the internal member. On sectioning, the bifid tentacle is seen to bear two encysted parasites, probably cercarian. The "eye" in the external member is seen to consist of a group of four eyes apparently proliferating one from another and constituting one series of three "generations," and another junior

series of two, the largest eye being common to both series. All these eyes are complete in all their parts (lens, retina, etc.), though differing greatly in size, development of optic nerve and degree of external abstriction. All are internally completely occluded except the least developed, which still connects by a lumen with its "parent" eye. The growth is orderly in that it secures (*a*) the same axial orientation, (*b*) the same polar orientation, (*c*) freedom from mutual interruption of vision, (*d*) nearly maximum compactness. No other possible arrangement secures all these. The mass of tissue in the group is greater than in the normal eye. The case is unique in the literature. The possibility that it represents not proliferation but unequal development of the fragments of a broken-up *anlage* is admitted, but rejected as a probability. If a true case of repetitive proliferation of such specialized structures as these eyes, then near analogies are lacking.

The following exhibits were presented:

Inheritance of Color in the Common Clover Butterfly (Colias philodice): (a) 125 Descendants (F_1 and F_2) of a White Female. (b) Offspring of an Aberrant Female of the Spring Brood, resembling the Arctic Species (Colias nastes, Boisd.): J. H. GEROULD, Dartmouth College.

Cytological and Other Characteristics of the Diverse Races of Paramecium: H. S. JENNINGS and G. T. HARGITT, Johns Hopkins University.

Specimens of the 1,500th Generation of Paramecium, attained without Artificial Stimulation or Conjugation: L. L. WOODRUFF, Yale University.

HERBERT W. RAND,
Secretary

HARVARD UNIVERSITY

THE ASSOCIATION OF OFFICIAL SEED ANALYSTS

THE second annual meeting of the Association of Official Seed Analysts was held in Boston, December 28–29, 1909, in connection with the meeting of the American Association for the Advancement of Science.

Agricultural colleges, experiment stations and state departments of agriculture in twelve states and the Canadian and the United States departments of agriculture were represented.

Three papers were presented as follows:

"The Effect of Alternating Temperature on the Germination of Seeds," by W. L. Goss, U. S. Department of Agriculture.

"Importance of Uniform Methods of Seed Testing," by A. D. Selby, Ohio Agricultural Experiment Station.

"The Sale of Adulterated Farm Seeds in the United States," by E. Brown, U. S. Department of Agriculture.

The greater part of the time of the meeting was devoted to consideration of the reports of the committees on methods of seed testing and on legislation. The report on methods of seed testing for purity was adopted as official by the association and that on germination as provisional. The report on state legislation was adopted and the secretary was instructed to prepare both reports for publication.

E. BROWN,
Secretary

SOCIETIES AND ACADEMIES

THE THIRD ANNUAL MEETING OF THE ILLINOIS STATE ACADEMY OF SCIENCE

IN attendance, number and character of papers presented, and in the general spirit of enthusiasm and interest, the meeting at Urbana, February 18 and 19, is regarded with great satisfaction by those who had the good fortune to be present.

More than one hundred new members were elected, so that now the academy, while but three years old, has something more than four hundred names enrolled on its list—a fact which speaks well both for the enthusiasm and the spirit of helpfulness of Illinois men of science, and which repudiates the idea that men of science are recluses.

About one hundred and fifty people were present at the various meetings.

The program was as follows:

"Dr. A. W. French," In Memoriam, A. R. Crook.

"A Needed Piece of Work in the Interest of our Young Investigators in Biology," T. W. Galloway.

"The Vegetational History of a Blowout," H. A. Gleason. (Lantern.)

"Recent Habitat Changes in the Illinois River," Chas. C. Adams. (Lantern.)

"Forest Successions on Isle Royale," Wm. S. Cooper. (Lantern.)

"An Ecological Study of the Fish of a Small Stream," Thomas L. Hankinson.

Address of welcome by the president of the University of Illinois.

Presidential address—"Relations of the Illinois Academy of Science to the State," Stephen A. Forbes.

"Informal Account of my Recent Oriental Trip," T. C. Chamberlin.

Reception given by the Illinois Chapter of Sigma Xi.

Symposium—

(*A*) "The Relation of Pure and Applied Science to the Progress of Knowledge and to Practical Affairs":

In Biology, Cornelius Betten, Lake Forest College.

In Chemistry, Julius Stieglitz, University of Chicago.

In Physics, John F. Hayford, Northwestern University.

(*B*) "The Relation of Pure and Applied Science to Secondary Education," C. G. Hopkins, University of Illinois, and Worrallo Whitney, Bowen High School, Chicago.

"The Passing of our Game Birds," Isaac E. Hess.

"Further Studies on the Influence of Copious Water-drinking with Meals," P. B. Hawk.

"Biology and other Sciences as applied by a Breeder," Q. I. Simpson.

"Report on the Ecology of the Skokie Marsh Area near Chicago, with special reference to its Mollusca," Frank C. Baker. (Lantern.)

"Ecological Succession of Fish and its bearing on Fish Culture," V. E. Shelford. (Lantern.)

"Forest Associations of Northwestern Illinois," H. S. Pepoon.

"Relic Dunes," Frank C. Gates. (Lantern.)

"On the Relation of the Jeffersonville Beds of Indiana to the Grand Tower (Onondaga) Limestone of Illinois," T. E. Savage.

"Observations on the Earthquake in the Upper Mississippi Valley, May 26, 1909," Johann August Udden.

The officers for the ensuing year are:

President—John M. Coulter, University of Chicago.

Vice-president—R. O. Graham, Illinois Wesleyan University.

Secretary—A. R. Crook, State Natural History Museum.

Treasurer—J. C. Hessler, James Millikin University.

Third Member Publication Committee—H. H. Stock, University of Illinois.

Membership Committee—Fred L. Charles, University of Illinois; Thomas L. Hankinson, Eastern Illinois State Normal; V. E. Shelford, University of Chicago; W. E. Tower, Englewood High School; Isabel Seymour Smith, Illinois College.

Committee on Ecological Survey—Stephen A. Forbes, V. E. Shelford, H. A. Gleason, E. N. Transeau, Frank C. Baker, Charles C. Adams.

Committee on Deep Drilling—J. A. Udden, U. S. Grant, Frank DeWolf.

Committee on Assistance of the Academy to High Schools in Science Teaching—C. J. Hopkins, John F. Hayford, John G. Coulter, Worrallo Whitney, W. S. Strode.

Committee to Influence Legislation in favor of increased Protection for Game Birds—Stephen A. Forbes, John M. Coulter, A. R. Crook, J. C. Hessler.

Committee to Influence Legislation to restrict the Collection of Birds and Eggs solely to Accredited Institutions—F. C. Baker, I. E. Hess, F. L. Charles.

Committee to cooperate with existing Agencies for the Advancement of Nature-study in Elementary Schools—Fred L. Charles, Ira Meyers and Ruth Marshall.

A. R. Crook,
Secretary

Springfield

The American Mathematical Society

The one hundred and forty-seventh regular meeting of the society was held at Columbia University on Saturday, February 26, 1910, twenty-eight members being in attendance. Ex-president W. F. Osgood occupied the chair at the morning session, Vice-president J. I. Hutchinson at the afternoon session. The council announced the election of the following persons to membership in the society: Mr. E. S. Allen, Berkshire School, Sheffield, Mass.; Mr. B. A. Bernstein, University of California; Mr. G. W. Evans, Charlestown High School, Boston, Mass.; Mr. C. E. Flanigan, Wheeling, W. Va.; Mr. C. E. Githins, Wheeling, W. Va.; Mr. J. S. Mikesh, University of Minnesota; Professor G. P. Paine, University of Minnesota; Mr. W. L. Putnam, Boston, Mass.; Mr. V. M. Spunar, Pittsburg, Pa. Nine applications for membership were received. The total membership of the society is now 623.

Committees were appointed to arrange for the summer meeting and to report on the matter of the publication of the Princeton Colloquium Lectures.

The Annual Register for 1910 has recently been issued, and copies can be obtained from the secretary. The catalogue of the library, which is published separately, includes over 3,000 volumes.

The following papers were read at the February meeting:

G. D. Birkhoff: "A simplified treatment of the regular singular point."

G. D. Birkhoff: "Some oscillation and comparison theorems."

P. F. Smith: "On osculating bands of surface-element loci."

Eduard Study: "Die natürlichen Gleichungen der analytischen Curven im euklidischen Raume."

G. A. Miller: "Addition to Sylow's theorem."

Peter Field: "On the circuits of a plane curve."

C. L. Bouton: "Examples of transcendental one-to-one transformations."

Jacob Westlund: "On the fundamental number of the algebraic number field $k(\sqrt{m})$."

L. P. Eisenhart: "Surfaces with isothermal representation of their lines of curvature and their transformations (second paper)."

Edward Kasner: "Isothermal nets."

Arthur Ranum: "On the principle of duality in spherical geometry."

O. E. Glenn: "On multiple factors of ternary and quaternary forms: applications to resolution of rational fractions."

The San Francisco Section of the society met at Stanford University on February 26. The Chicago Section meets at the University of Chicago on Friday and Saturday, April 8–9. The next regular meeting of the society will be held at Columbia University on Saturday, April 30.

F. N. COLE,
Secretary

THE BIOLOGICAL SOCIETY OF WASHINGTON

THE 466th regular meeting of the society was held on February 12, 1910, in the main lecture hall of George Washington University, with Vice-president E. W. Nelson in the chair and a large attendance of members.

Under the heading "Brief Notes," Dr. Barton W. Evermann told of recent experiments in feeding fur-seals in captivity made by Mr. Judson Thurber, boatswain of the Revenue Cutter *Bear*. Two starving seal pups were captured on the Pribilof Islands, October 9, 1909, and delivered to the *Bear* on October 14. They were fed on condensed milk and later on fish, and were successfully conveyed to Seattle, and thence to Washington, where they are now on exhibition at the Fisheries Building, both in excellent health. It is hoped that the practical outcome of this experiment will be the saving of a large number of the young seals on the Pribilofs that are usually lost because of the destruction of the mothers through pelagic sealing.

The following communications were presented:

On Alaskan and Far Northern Mosquitoes: L. O. HOWARD.

Dr. Howard spoke briefly on Alaskan and other far-northern mosquitoes, quoting from the published accounts of arctic explorers and from letters received from travelers in Alaska and other sub-polar and polar regions. It appears that in the short arctic summer mosquitoes are excessively numerous and bloodthirsty, although the number of species involved is apparently very small. Most of the species from such regions in the collection of the National Museum, on the authority of Mr. F. Knab, belong to the genus *Ædes*, a group which winter in the egg state and produce a single generation upon the melting of the snows. The development of the larvæ is rapid and almost simultaneous, resulting in a veritable explosion of adult mosquitoes.

A Collecting Trip to Alaska (illustrated by lantern slides): A. S. HITCHCOCK.

During the summer of 1909, Professor Hitchcock, systematic agrostologist, U. S. Department of Agriculture, made a trip through interior Alaska for the purpose of studying and collecting the grasses of this region, which is comparatively little known botanically. Starting from Seattle, June 15, he visited Juneau, Sitka and Cordova, from which latter point an excursion was made up the Copper River on the new railroad to Miles Glacier. Returning to Juneau, he went to Skagway and over the White Pass to White Horse, where he was joined by Mr. R. S. Kellogg, of the Forest Service. Besides short stops at intermediate points, he visited Dawson, Rampart, Hot Springs, Fairbanks, Fort Gibbon, St. Michael and Nome, returning to Seattle direct.

Alaska consists of several well-marked regions. The coast region lies between the coast and the extension of the Cascade range of mountains, which becomes the Alaska Range. This high range includes the high peaks, Mt. St. Elias and Mt. McKinley. The climate of this region, extending from Ketchikan in southeastern Alaska to Cook Inlet, is similar to that of the Puget Sound region. It is characterized by great rainfall (111 inches at Sitka; as much as 60 feet of snow in winter at Valdez), equable temperature (it is no colder in winter at Sitka than at Washington), and the prevalence of cloudy and foggy days. The Yukon Basin, which includes a large part of the interior, has, on the contrary, a continental cli-

mate. The winters are very cold, while the temperature in summer may be uncomfortably warm, not infrequently above 90° F. in the shade. The rainfall is small (10 to 14 inches) and the weather is normally clear and pleasant. The Yukon Basin is separated from the Arctic Slope by a low range of mountains, the continuation of the Great Continental Divide. The greater portion of Alaska is timbered, the southeastern portion quite densely so, the timbered area including all except the Alaska Peninsula and the Aleutian Islands, the deltas of the Yukon and Kuskokwim rivers, most of Seward Peninsula, and the Arctic Slope. The timber line is usually between 2,000 and 3,000 feet altitude. Except along the rivers, the forests of interior Alaska are sparse and scattered, the trees being rarely over one foot in diameter. In this region the prevailing species are white and black spruce (*Picea canadensis* and *P. mariana*), aspen (*Populus tremuloides*) and white birch (*Betula alaskana*).

The conditions at Hot Springs are of special interest. The hot water is used for a variety of purposes, including the heating of greennouses and a large hotel. The soil conditions over an area of several acres are so modified that the flora is quite distinct. Many plants were observed here and in no other locality in Alaska, plants which are native much further south. The timber on this area is distinctly larger. Mr. Kellogg noted an aspen eighteen inches in diameter, and the large birch trees were conspicuous.

Especial attention was given to the grasses, of which 900 numbers were collected. The grasses of the coast region are well known, this region having been visited by several botanists. Few collectors have penetrated to the interior and our knowledge of the grass flora of this large and interesting region is very meager. The number of species of grasses is small, surprisingly so if we exclude the recent immigrants. Nevertheless, the grasses form a very important part of the flora. The dominant genus is *Calamagrostis*, of which there are several species. *Arctagrostis arundinacea* and species of *Calamagrostis*, especially *C. canadensis*, form the bulk of the grass flora, and may cover vast areas in the more or less open spruce forest.

In spite of the low rainfall and the comparatively dry summers, the soil is usually cold and moist in the valleys and often on the lower mountain slopes. This is due to the poor drainage. The soil is permanently frozen for several yards below the surface, a thin surface layer thawing out each summer.

The tundra region of Nome is distinctly different from the interior and from the southern coast. The lack of trees and the more severe climate modify the flora. The tundra itself, marshy land with ponds and lakes interspersed, contains few grasses, the grass-like plants being mostly sedges. The hills and sandy or gravelly knolls show, however, a greater variety of grasses than the interior valleys. The flora of Nome is scarcely arctic, though many arctic species are found here. The true arctic flora is found on the Arctic Slope and extends down along the coast to the north shore of Seward Peninsula.

D. E. Lantz,
Recording Secretary

THE CHEMICAL SOCIETY OF WASHINGTON

The 196th meeting was held in the lecture hall of the public library on February 10, 1910. President Failyer presided, the attendance being 79. The following committee was appointed to solicit subscriptions for the George Washington Memorial building: F. P. Dewey, W. F. Hillebrand, E. T. Allen, W. N. Berg, F. K. Cameron, V. K. Chesnut, E. A. Hill, C. S. Hudson, W. B. D. Penniman, C. A. Rouiller, A. Seidell. S. S. Voorhees.

F. P. Dewey read a paper on the "Solubility of Gold in Nitric Acid," in which he showed that contrary to the usually accepted opinion, gold, especially when finely divided, is easily soluble in boiling nitric acid of 1.42 sp. gr. Various yellow solutions containing 100 to 200 mg. of gold per liter were prepared, while one solution carried over 660 mg. of gold per liter.

C. L. Alsberg and O. F. Black presented a paper on the "Detection of the Deterioration of Corn with special Reference to Pellagra." Dr. Alsberg presented the paper and showed that the etiological connection between pellagra and spoiled corn was regarded by several European governments as so probable that stringent grain inspection laws have been passed. Inspection is effective only when done with chemical methods. These methods were discussed on the basis of analytical studies. The conclusion reached was that, while no single method is applicable in all cases, the acidity, determined according to a fixed procedure, is the best single criterion for estimating the degree of deterioration.

J. A. Le Clerc,
Secretary